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ABSTRACT

This program for the 1994 Association for Learning Technology Conference provides a conference schedule and summarizes the presentations of the discussion workshops, hands-on workshops, live demonstrations, and poster sessions. Abstracts of the following papers presented at the conference are included: "The Conceptualisation Cycle" (J. Mayes & L. Coventry); "Interactive Computer-Assisted Reflective Learning" (J. Cook); "Evolving Principles of Performance Support" (P. Barker & A. Banerji); Designing Interactive Multimedia Applications for Flexible Learning Strategies" (R. McLeod); "Teams, Technology and Knowledge" (D. Anthony Wilson); "Specification and Implementation of an 'Active Learning' Facility" (R. Boyle); "Case Study: Sainsbury's Evolving Learning Technology" (D. Hawkridge & L. Houldsworth); "Successful Implementations of CAL in Dutch Higher Education" (M. Mirande & M. Leiblum); "Support of Learning Using an Architecture for CSCW for Engineering Design" (J. Gammack, D. Jenkins, S. Kydd, & S. Tian); "The Implementation of a Multimedia Learning Environment for Graduate Civil Engineers" (C. Smith & P. Jagodzinski); "Enabling Active Learning through Technology in Higher Education" (R. Macredie & P. Thomas); "A Strategic Multidisciplinary Team Approach to HE Learning Environments" (I. Smith & J. Smith); "A Realistic Strategy for Institutional Commitment to Courseware Development in Universities" (I. Benest, A. Hague, & J. Fritz); "Multimedia Courseware" (I. M. Marshall, W. B. Samson, & P. I. Dugard); "The Demonstrator Model of Learning Design and the Effective Use of Multimedia" (T. King); "Learning Style and Learning Strategies in a Multimedia Environment" (P. Paterson & J. Rosbottom); "Meeting and Discovering Language Learning Needs" (J. Gillespie); "It Doesn't Interrupt Me When I'm Thinking, and You Do!" (S. Hewer); "ISDN--The Distance-Learning Solution" (G. Jacobs); "Learning Assistance on Wider Access Courses" (J. Lomax); "Mole: Computer Mediated Collaborative Learning" (D. Whittington); "VIRGIL Reality" (A. Cook, N. Oxley, & R. Baird); "The Use of Computers as Substitute Tutors for Marketing Students" (M. Catterall & P. Ibbotson); "Intelligent Tutoring Systems" (M. Elsom-Cook); "Development and Implementation of a Multimedia Teaching Package in Comparative Literature" (B. Heins, C. Larrea, & C. Burnley); "Meeting Academic Objectives for Distance Learning with CD ROM" (G. Einon, M. Jones, N. Heap, & M. Karlsson); "Institutional Support for Change in Teaching and Learning" (M. Oates); "Towards the Institutionalisation of

Learning Technologies in Higher Education" (J. Rothwell); and the keynote address--"Toward a National Learning Infrastructure" (W. Graves). (MES)

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ALT

ASSOCIATION FOR LEARNING TECHNOLOGY

Conference 94

Enabling Active Learning

Conference programme and abstracts

Monday 19 September to
Wednesday 21 September

at the University of Hull

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Association for Learning Technology

Conference 94

Enabling Active Learning

Conference programme and abstracts

Conference Committee

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Monday 19 September to
Wednesday 21 September

at the University of Hull

Association for Learning Technology Administration, University of Oxford, 13 Banbury Road, Oxford, UK

Introduction

Conference Aim

The UK Higher Educational Funding Councils and other organisations have made very substantial investments in projects relating to the application of learning technology. In doing so they have challenged staff in higher education institutions to demonstrate success in implementing what is still largely a novel approach in teaching and training. Not only must the products be educationally effective, visually attractive, technically robust and capable of being used on a wide variety of platforms, but appropriate delivery strategies must also be in place to ensure success. The introduction of the technology must not frustrate learning but rather actively engage, challenge and motivate the student or trainee.

The first conference will be a unique opportunity for members of the Association to share and be inspired by each other's experience and expertise in addressing this challenge. **The aim is to identify WINNING SOLUTIONS**: from corporate strategy, to courseware design; in supporting students in the use of technology in learning, to the inspired use of tools and techniques.

Conference Format

The conference programme is designed for active participation. The emphasis is on discussion workshops, hands-on workshops and live demonstrations. Indeed we hope that some discussion groups may wish to continue beyond the conference. In addition there will be two paper sessions. To allow for effective small group discussions there are a number of parallel sessions in each section of the Conference. This approach emphasises the theme of the conference enabling active learning. You will need to select which sessions are of interest to you before coming to the Conference.

The keynote address ***Towards a National Learning Infrastructure***, is to be presented by Professor Bill Graves from the University of North Carolina. For an abstract of his presentation, see page 97. This address is sponsored through the generosity of BT.

Outline structure of the Conference

Day 1 Monday 19 September

14.00	Welcome and Introduction
14.45	Paper Presentations for the Live Demonstrations (7 parallel sessions)
16.00	Live Demonstration Session

Day 2 Tuesday 20 September

09.00	Workshop Session 1 (8 parallel sessions)
11.30	Paper Session 1 (7 parallel sessions)
12.30	Live Demonstration Session
14.30	Paper Session 2 (7 parallel sessions)
16.00	Workshop Session 2 (8 parallel sessions)

Day 3 Wednesday 21 September

09.00	Workshop Session 3 (8 parallel sessions)
11.30	Keynote address
12.30	Conference closes

The detailed Programme follows on page 3, and is the contents list for the following abstracts. The Discussion Workshops and Hands-on Workshops have been grouped as isited below. You will be able to identify sessions in the detailed Programme of particular interest to you from the reference code in this list (**D** for Discussion Workshops and **H** for Hands-on Workshops plus a numeral).

Discussion Workshops

The application of educational R & D.
D1 Designing software to maximise learning

Using technology to support student learning
D2 Information access
D7 Learning with CAL courseware
D13 Approaches to student assessment
D14 Skills training for students

Computer mediated communication
D8 Accessing the global database
D17 Supporting the learner at a distance

Courseware development
D3 Project management
D9 Managing the courseware development life cycle
D15 Evaluation of CAL courseware

Tools and techniques for development
D4 Advanced solutions to courseware development
D10 Low cost approaches to courseware development
D16 CAL development methodologies

Departmental/Course strategy
D5 Developing and executing a departmental policy for using learning technology
D11 Developing a course to take advantage of learning technology

Corporate strategy
D6 Supporting lecturers in the production of learning technology resources
D12 Approaches that work
D18 Developing an institutional teaching and learning strategy
D19 Promoting and sustaining change

Hands-on Workshops

H1 Introduction to Microcosm
H2 The use of KnowledgePro for Windows for CAL
H3 Mathwise: computer-based learning of discrete mathematics
H4 COSACC - the hands-on synchronous groupware simulation for the teaching of cost accounting
H5 Full colour movies and images in Macintosh and Windows based CAL applications
H6 Text based and computer based learning materials in the teaching of structural mechanics - an integrated approach to course development

You are asked to select in advance of the Conference the Workshop sessions that you wish to attend, and to return the enclosed form noting your selection to the Conference Administrator.

Conference Programme

Monday 19 September 1994 **Page**

10.00 - 12.00 Registration in Halls of Residence and at Grange Hotel

12.30 Buffet Lunch

14.00 Opening and Welcome:
Professor David Dilks - Vice Chancellor, Hull University

14.10 **What do we need learning technology for?**
Jonathan Darby - President, Alt.

14.45 - 15.45 Paper Presentations for the Live Demonstration Sessions

Group 1

- **Computer based simulation as an alternative to laboratory experimentation.** *N. Edward.* 11
- **Bridging the gap between theory and practice in the field of biotechnology.** *R. Jenkins.* 11
- **Electronic laboratory work enhanced by computer animation and simulation.** *P. Lawton.* 12
- **Computer simulated experiments in active learning.** *J. Leary.* 12
- **Microwave workshop for windows.** *C. White.* 13
- **A simulated laboratory experiment using task switching.** *P. Aaron.* 13

Group 2

- **Information skills: development issues encountered in producing CAL packages for the TILT project.** *L. Creanor.* 15
- **Development of a software tool and function library to assist in the teaching of logical neural networks.** *J. O'Shea, Z. Bandar and S. Cooper.* 15
- **A multimedia handbook for engineering design.** C. McMahon, *D.Pitt and C. Julian.* 16
- **Selecting software for successful courseware.** *B. Watson.* 16
- **Training students in database search strategy using CD ROM and computer aided learning technology.** *A. Hilton and R. Rouse.* 17
- **Development of and interactive guide to library services** *J. Kennedy and I. Cantley.* 17

Group 3

- **Using information technology to help business students learn about contract.** *J. Edwards and R. Akroyd.* 19
- **Multimedia language - learning materials using voice recognition technology to evaluate learner response.** *R. Gallery.* 19
- **Towards an integrated learning environment in business french.** *A. Pugh.* 19
- **The TLTP Pharma-CAL-ogy Project - strategies and implementations.** *D. Dewhurst and I. Hughes.* 20
- **Interactive learning environments on a campus network.** *F. Arshad, L. Conkar and P. Ward.* 20

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- **Teaching practical research skills: the classification of social interaction in political interviews.** *L. Allison and P. Bull.* 22
- **From generation to generation - separation of content from functionality in interactive language training courses.** *P. Bangs.* 22
- **MENTOR: multimedia educational technology for operational research.** *K. Downsland, J. Clifford and E. Stone.* 23
- **LOGIFRENCH - French grammar with Testmaster.** *M. L'Huillier.* 23
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Group 5

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- **SPACTeach - Exploring the soil/plant/atmosphere continuum.** *L. Simmonds and J. Schofield.* 25
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- **Developing CAL for archaeology: the approach of the TLTP Archaeology Consortium**. *E. Campbell.* 35
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- **Integrating business and IT learning in computer supported teamworking**. *J. Gammack and A. Hutchison.* 36
- **An approach to Recursion - using the EROSI tutor.** *C. George.* 36
- **Basic Chemistry - interactive problem solving - CAL software.** *B. Hathaway, B. Murphy, C. Murphy, J. Moran, M. O'Leary, B. O'Sullivan, G. Hyde and P. O'Keefe.* 37
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- **A review of the teaching of financial information systems in the school of financial studies and law at Sheffield Hallam University.** *G. Hill and M. May.* 37
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- **Writing courseware for service teaching in science at Wolverhampton University**. *M. Thelwall and R. Binns.* 42

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19.00 Buffet Dinner

21.00 Live Demonstrations and Poster Session closes.

Tuesday 20 September 1994

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		• **Designing interactive multimedia applications for flexible learning strategies.** *R. McLeod.*	58
	P3	• **Teams, technology and knowledge: A strategy for optimising the environment for organisational learning.** *D. Wilson.*	59
		• **Specification and implementation of an `Active Learning' facility.** *R. Boyle.*	59
	P4	• **Case study: Sainsbury's evolving learning technology.** *D. Hawkridge and L. Houldsworth.*	60
		• **Successful implementations of CAL in dutch higher education** *M. Mirande and M. Leiblum.*	60
	P5	• **Support of learning using an architecture for CSCW for engineering design.** *J. Gammack, D. Jenkins, S. Kydd and S. Tian.*	61
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H3 **Mathwise: computer based learning of discrete mathematics**. *D. Mackie and P. Thomson.* 84

H4 **COSACC - the hands-on synchronous groupware simulation for the teaching of cost accounting**. *C. Gray.* 84

20.00 Conference Dinner

Wednesday 21 September 1994

09.00 - 11.00 **Discussion (D) and Hands-on (H) Workshops Session 3**

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- **The impact of some critical institutional and strategic issues on the implementation of a university wide teaching and learning policy.** *A. McCartan and M. Hodgson.* 93
- **The development of a new learning environment at the University of Humberside.** *S. Shipley.* 93

D19 **Promoting and sustaining change -**
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11.00 Coffee

11.30-12.30 **Keynote Address -**

Professor Bill Graves, University of North Carolina:
Towards a National Learning Infrastructure. 97

12.30 Buffet Lunch and End of Conference.

Live Demonstrations

GROUP 1

Computer based simulation as an alternative to laboratory experimentation

N. Edward (Faculty of Science and Technology, Robert Gordon University, Aberdeen)

There is much debate about whether engineering students gain anything from actually using equipment in laboratories. Could the same objectives be met by a simulation which allows the student to control the progress of the experiment and gives results representative of what would be obtained on the actual machinery? Are there objectives which cannot be met? Conversely are there possibilities which can only be permitted on a simulation e.g. to avoid damaging equipment?

It is proposed to run a workshop/discussion session at which participants could try a number of simulated mechanical engineering experiments on computer. We would then discuss some of the following:

- What are the objectives of practical experimentation?
- Do we generally attain these objectives in a typical laboratory session?
- How well can these objectives be met by a good quality simulation?
- Are there any areas where simulation offers advantages over practical work?
- What are the desirable features of a 'good' simulation?
- How should the package be presented and is there a need for other support materials?
- How should CBS packages be evaluated?

Participants would be expected to gain an appreciation of some of the current developments in simulation and to draw conclusions on its advantages and disadvantages.

Bridging the gap between theory and practice in the field of biotechnology

R. Jenkins (Department of Applied Biology & Biotechnology, De Montfort University, Leicester)

The increasingly important role played by biotechnology in a wide range of industries has caused problems of specific skill shortages. As a fast moving field, composed of many subjects often cutting across conventional disciplinary boundaries, biotechnology demands specialised knowledge and skills. Training and frequent updating of staff are essential to enable enterprises to keep abreast of new developments. Recent developments in the production of wide ranging open learning texts for biotechnology, coupled to course validation based on these materials, has opened opportunities to study biotechnology without extended full-time of part-time attendance at university of college.

To support delivery of the practice of biotechnology, interactive software packages provide experience in decision making in many of the enabling technologies. The programs, developed using Authorware Professional, are set in an industrial environment, the user being given a realistic problem to solve, objective to achieve or process to develop. They simulate the practical problems and decisions that need to be addressed in planning, setting up and carrying out research and development experiments and production processes. Each program has an extensive library including basic concepts, experimental techniques, data and units. Whilst the programs do not replace the need to learn manipulative skills and practice them in the laboratory, they do provide experience in what experiments to do in the laboratory, what data to collect and how to process it, all in a fraction of the time that would be taken in the actual laboratory. In so doing they challenge the students understanding of the subject and help to bridge the gap between theory and practice.

Electronic laboratory work enhanced by computer animation and simulation.

P. Lawton (Department of Electronic and Electrical Engineering, DeMontfort University, Leicester)

This paper reviews the experience of providing Laboratory work, computers and relevant programs, to assist the learning of Electronic/Electrical Principles.

Engineers, Calculators and Computers.
Engineers are involved with repetitive calculations the results of which are often displayed as graphs. For example Resistance, Reactance, and Impedance. The computer can undertake the repetitive calculations and display the graphs. An important calculation is the square root of the sum of the squares. An important graph is the Frequency Response (The Bode Diagram). Other graphs plot sinusoids, and synthesis from harmonics.

Students at DeMontfort University are timetabled to laboratory work. This involves comparing measurements with predictions derived longhand and then from computer programs. They also tackle a range of tutorial problems relating to resistors, inductors, capacitors linked to frequency responses and harmonics. A laboratory unit is provided called the R-L-C-R box (1k 10mH 10nF 1k)

A computer program is used called IC (Impedance and Complex Number Calculations, ref 2)
Also a book and programs :- Electric Circuit Theory by B.E.Riches (ref 3)
Many Graduates express satisfaction with this laboratory experience.

As well as supporting laboratory work the computer programs are used to emphasise important ideas in the lecture theatre via a video projector. (Bode diagrams and Fourier synthesis)

A current project is investigating recent programs :-
Electronics Work Bench
Animated Circuits for Education
Windows Paintbrush (Images)

Finally, the purpose remains the same, namely to introduce undergraduates to the fundamental principles of Electronic Engineering. The laboratory work linked with the computer programs appeals to the majority of the undergraduates. The Animated Circuits for Education appeals to the author as they illustrate flow (of electric charge q, $i=q/t$)

Computer simulated experiments in active learning

J. Leary (Department of Mathematical Sciences, University of Brighton)

This paper describes a programme of research within the University of Brighton in encouraging active learning in science by using computer simulated experiments. These accompany traditional lectures and help ensure that students come to grips with the course material within a short time after each lecture.

The computer simulated experiments are being designed to replace and extend traditional laboratory-based experiments, initially in the field of Fuels and Combustion, where otherwise experiments would be difficult to include. For example: measurement of pollutant emissions from a spark ignition engine, calorific value using a Boy's calorimeter, kinematic viscosity using the Redwood viscometer, flame speed, combustion efficiency of a fluidised bed incinerator, flash
point of liquid fuels, and determination of fractional components using a distillation column. The experiments show cut-away views of apparatus and are interactive.

The paper also identifies key aspects of computer games which increase motivation and fascination, such as intrinsic rewards, matching of level of difficulty to level of competence and achieving flow, and describes how these can be used in computer simulations for educational purposes to improve student self-motivation. The advantages and disadvantages of practical laboratory based experiments and computer simulations are discussed. The paper then describes a typical computer simulated experiment in detail, describing the software technology and the process of production, and explains how the various program modules are linked together using dynamic link libraries.

Student feedback has shown clearly that the students were better motivated, learned the inner workings of the equipment, and felt they had understood the theory behind the experiment more quickly than if they had performed the real experiment.

Educational issues are discussed in detail, particularly the learning processes involved in scientific experimentation.

Microwave workshop for windows

C. White (Department of Applied Physics, University of Portsmouth)

A suite of programs have been developed to support the teaching of Microwave theory and design. Presently, three programs reside under a Windows "Group" which is entitled *Microwave Workshop for Windows.* A secondary function of the package is to support microwave engineers by providing a library of utilities to aid their design function.

All three programs were written in Visual Basic and are highly user friendly.
Program one is called *Smith Chart.* The Smith Chart is one of the most important tools for the microwave engineer and yet students find the concepts of its application difficult to grasp using tradition teaching methods. The program commences by illustrating the derivation of the chart. Colourful are used throughout the program to consolidate the main aspects of the chart. It then progresses to a series of graded examples which the computer, in a stepwise manner, proceeds to solve. The program also possesses a powerful automated chart which may be used independently.

Program two is called *Microlab.* This is a virtual microwave laboratory and includes all the waveguide components one would reasonably expect to see in such a laboratory. The components can be connected in any combination and a generator and detector can be connected to the circuit ports. Important parameters can be varied by the student and results in terms of power or Voltage Standing Wave Ratio can be observed.

Program three is called *Microwave Devices* and is simply a hypertext interpretation of lecture course notes describing a wide range of devices at three levels of complexity. Level 1 reflects the requirements of a Higher Diploma unit, level 2 corresponds to final year degree level, and the highest level supports postgraduate teaching within the institution.

A simulated laboratory experiment using task switching.

P Aaron (School of Engineering, Coventry University)

Computer programmes such as Electronic Workbench provide an environment in which the student may extend his knowledge and experience in a number of ways. The simulation of the

laboratory workbench provides some advantages over straight forward analysis programmes as well as having some limitations.

This particular exercise is part of an on going programme for using computers as part of the learning process. It is developed from a traditional laboratory experiment which has the objectives of reinforcing the theory of network matrix parameters and of providing a good illustration of the use of measurement technique and error analysis.

The instructions for performing the experiment are presented using an authoring system. Rather than calling the simulation programme form the author system both programmes are run and the student can switch between them at will. This gives a very fast and convenient way to move between guidance notes and simulation. Windows version 3.1 achieves this quite reliably and Desqview is as good for non-Windows users. The author system material must be written in the knowledge that there are no positional links between it and the simulation.

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The advantages of a laboratory simulation include :

- a lighter load on specialist laboratory space,
- a lighter load on specialist laboratory equipment,
- no supervision is required from the safety aspect,
- enables the student to work at his own pace, to repeat parts of the experiment if necessary
- and to schedule his time more flexibly,
- used in conjunction with the author system a sophisticated help can be provided and a summative assessment incorporated.
- The increased load on computer provision must be recognised and it would be undesirable
- to have too large a ratio of simulated to real laboratory exercises.

GROUP 2

Information Skills: development issues encountered in producing CAL packages for the TILT project.

L. Creanor (TILT Research Assistant, Glasgow University Library)

Glasgow University received funding in the first round of the Higher Education Funding Council's TLTP program for its institutional Teaching with Independent Learning Technologies (TILT) project. As part of this project, the Library is developing a number of hypertext Information Skills CAL packages which are aimed mainly at first and second year undergraduates. As the project progresses we are continually learning and re-considering our approach, and this paper will investigate some of the development issues which have come to light.

Our initial intentions however remain unchanged. These are:-

- to produce computer-aided learning modules covering the areas of information skills and study skills which can be used either independently by students or in seminar situations.
- to investigate similar developments at other institutions and to adapt any material which might be suitable for the project.

Examples from the various packages under development will be used to illustrate how these points have been accommodated, from the first early attempt at a CAL tutorial for the Biological Abstracts on CD-ROM database to the recently completed Computer Sources module which builds on this. The adaptation of a large package on Information Skills for Business Studies Students developed by a PhD student at Robert Gordon University in Aberdeen will also be demonstrated. Aspects of the design will be discussed from the decisions which led to the choice of authoring software, including the change from GUIDE to Toolbook, to the modular design of the packages themselves.

The paper proposes to illustrate the reasons behind the decisions made and the learning process which continues to take place.

Development of a software tool and function library to assist in the teaching of logical neural networks.

J. O'Shea, Z. Bandar and S. Cooper (Department of Computing, Manchester Metropolitan University)

A number of software tools have been produced to assist designers in prototyping Artificial Neural Networks by means of software models. These tools have been adopted by Universities as a simple and cost-effective means of teaching the principles of ANN's to students on Computing and Engineering courses. These tools tend to focus on a variety of connectionist architectures. This paper presents RAMPANT, a tool for creating and demonstrating Logical Neural Networks (LNNs), together with a function library which students can use to embed LNNs in conventional C or C++ programs.

The paper begins with a general introduction to Neural Networks and an overview of concepts such as training, generalisation, and classification which must be grasped by students at an early stage of learning in this field. We then describe Logical Neural Networks, including an explanation of their mechanism, their advantages and disadvantages when compared with their connectionist counterparts, and a description of the types of problems to which they have been successfully applied. This is followed by a description of the original version RAMPANT and its application to hand-written character recognition by students combining Computing and Printing Technology. The improvements and revisions incorporated to produce the associated discriminator class are discussed.

The paper concludes with a review of the experience to date in using the tool for teaching on final year B.Sc. and M.Sc. Neural Networks modules and student projects, and a summary of proposed future work.

A multi-media handbook for engineering design

C. McMahon, D. Pitt and J. Cooke (Faculty of Engineering, University of Bristol)

Review is an Windows-based environment which has been developed at Bristol for viewing, indexing and enriching information from a wide variety of sources through a single convenient interface. It can be used to: a) index and view existing files on a system, b) add text, lines and other annotation to items, c) search and browse heterogeneous data, d) create hypertext links between data items, e) generate simple forms for data display.

The system combines database, hypertext and graphics features in a hybrid which was originally conceived as a means of improving access to engineering design data (drawings, analyses, reports, catalogues, standards...) but which has proved more generally applicable, particularly in areas where information types are diverse and feature significant graphical content.

Review is currently being used to develop a computer based handbook for use in the Engineering Departments of HE institutions for the support of studio-based design teaching as part of a two year HEFC funded project. Data sets relating to engineering design are being collected and built into a number of linked information bases in five major groupings:
Design Guides. These include "how to do it" guides for a variety of design situations - for example: transmission elements, fasteners, seals, etc.
Catalogue Information from component manufacturers. This will be linked to the design guide information so that standard sizes etc. can be quickly referenced .
Good Practice Guidelines. For example - design for casting, forging, machining, etc.
Materials Information. This will include standard data sets of engineering materials.
Standards. Drawing standards etc.

Selecting software for successful courseware

B. Watson (IT Service, University of Durham)

The success of courseware in achieving educational objectives is in part dependent upon selecting the most appropriate development tool. The learning objectives must be analysed and then clearly defined in order to evaluate which software would be most suitable to achieve these educational goals.

Consequently, at the University of Durham, courseware has been developed in:

- the core spreadsheet application - Quattro P*ro for Windows.
- the assessment package - Question Mark Professional
- the authoring package - ToolBook

Learning Errors in Measurement in Chemistry is written in the University recommended spreadsheet Quattro Pro for Windows to utilise its **spreadsheet functions**. The first year Chemistry students start by acquiring a foundation knowledge of Quattro Pro, using the self-study guides of the Computer Literacy Programme. The students then learn interactively using the CAL material in supervised practical sessions as an integrated part of their course.

Question Mark Professional is an easy to use program that has been developed for computerised assessment and examination. The strength of this tool is its **analysis** and **reporting** facilities. As part of the preparation for a departmental test, a General Knowledge Test has been written to enable the students to attempt the different question types available in Question Mark.

Until recently Spanish syntax had been taught using only lecture notes. Students have found this topic difficult to grasp and the aim of this project is to use the **hypermedia** facilities of ToolBook to enhance the learning of the subject material through interactive examples and tests.

Selecting the most appropriate software for the development of courseware has resulted in successful and enjoyable learning over the campus-wide network.

Training students in database search strategy using CDROM and computer aided learning technology

A. Hilton and R. Rouse (De Montfort University, Leicester)

De Montfort University has developed a Student Learning Development Centre, using activity based open learning strategies. Choice of media for delivery is governed by appropriateness rather than economic expediency.

The objectives were:

- That CDRoms should be used for practising the search skills rather than allowing students access to online.
- That the training should be available at the CDRom servers in the library since the databases were in electronic format
- That the CAL package would have the facility of 'dropping out' and 'dropping into' real CDRoms
- That there would be a subject guide to the CDRoms available
- That the package would ship in screens from CDRoms to prepare students for the very wide diversity in presentation

The need for the package arose from the fast growing array of databases, most of which are in CDRom format and include a diverse range of information some of which is full text, some is bibliographic with abstracts.

The apparent ease of access to these sources of information meant that students have been eager to try them out but dis-inclined to be critical of the results. It is clear that students had to be given the skills for using them advisedly.

It was agreed that the package would include database definitions, types of database, search strategy and search techniques supported by worked examples and direct access to databases for activity based development of skills.

A wide range of skills were needed for the execution of the project, including training in presenting learning in activity based open learning format, knowledge of authoring packages and a thorough knowledge of the library network.

No one person had all these skills, therefore the development of the package needed several departments (in particular The Division of Learning Development (DLD) and The Centre for Educational Technology & Development (CETD)).

The package is now on the network and undergoing evaluation.

Development of an interactive guide to library services

J. Kennedy and I. Cantley (Computer Services Department, University of Ulster)

Staff from the Library and Academic Computing Services sections of the University of Ulster's Educational Services Department (UUES) have been collaborating on the development of a multimedia hypertext guide to the Library. The MS-Windows based system is being developed using version 3.1 of the Guide hypermedia system. Guide was chosen as the delivery vehicle because of the potential for developing highly intuitive graphical interfaces to information resources, its capability to incorporate scanned images, and the possibility of establishing links to existing computer-based library systems, e.g., the on-line public access catalogue (OPAC). UU is a four-campus university but the prototype system has been developed with specific reference to the Jordanstown campus library.

The opening menu of the guide consists of a map of Ulster and, when the user selects a particular campus by clicking on it, they are presented with an index to library services on that campus. The hypermedia-based index to library services is complemented by an interactive floor plan component, which allows users to explore the geography of the library building and to discover the location of its services and collections. Some innovative features have been included in this module, e.g., when the user clicks on icons indicating the location of the library *OPAC terminals, an actual on-line search can be initiated in a window overlaying the floor plan.

The prototype of the system has been made available to the user community via the library networked information server, together with a range of other computer-based learning materials, e.g., statistical tutorials, generic study skills software, etc. Initial user feedback on the guide has been positive but we are currently planning a comprehensive usability / evaluation study of the system. Following the evaluation period we plan to extend the system to cover the other three campus libraries.

GROUP 3

Using information technology to help business students learn about contract law

J. Edwards and R. Akroyd (Aston Business School, Aston University, Birmingham)

This paper describes continuing work in using information technology (IT) to help business students learn about contract law. Business students and business people have a different perspective on law to that of law students and lawyers. The approach adopted here is motivated in part by the differing learning needs that result from this difference of perspective. It uses a model of the contracting process as being one of negotiation, where the decisions made by the parties involve the acceptance (or rejection) of certain risks. Normal "discussion" tutorials are therefore replaced by a role-play exercise in which students learn by taking part in simulated negotiations, each interested party being represented by a group of students. IT is being introduced into the learning process, both to support the individual student groups, and to improve the mechanics of the exercise.

Support for the individual student groups covers two aspects:

> the choice of the appropriate clauses to include in a contract being drawn up;
>
> the determination of what is a reasonable level of risk to accept in negotiating a particular contractual relationship, and what trade-offs there may be.

Support for the first is provided by SALES CONTRACTOR, a decision support system built using the expert system shell Xi Plus. Support for the second is provided by CONTRACT NEGOTIATOR, a decision support system written in the hypertext package Guide. The paper describes the structure and implementation of these two systems, and reports initial experiences of their use by students.

The paper will also describe progress so far towards using IT in the negotiating process, for example by using electronic mail to link groups of students in different places (which might be in different countries). This work is less developed than the individual support, but offers considerable prospects for the future.

Multimedia language-learning materials using voice-recognition technology to evaluate learner response

R. Gallery (Faculty of Languages and European Studies, University of the West of England, Bristol)

The demonstration will describe work in progress on a Lingua funded project with French and Italian partners to develop multimedia foreign language scenarios and exercises that exploit voice recognition technology to enable the learner's spoken responses to be evaluated by computer.

A number of existing courses allow the learner to repeat a heard stimulus; these materials go one step further and measure the learner response against a correct model. Depending on the accuracy of the response the learner is able to proceed through the dialogue or is required to repeat the response until it is 'understood' by the computer. To aid the learner in his/her corrections, a graph of their version can be seen and compared with the computer's model answer. The original product was developed using a non-standard sound card and user-interface. This new release will run under Windows and use a Soundblaster compatible card. Materials are currently being written in French, English and Italian. Subject to Lingua funding being extended, it is intended to increase the number of business scenarios and add further languages.

Towards an integrated learning environment for business French

A. Pugh (Language Centre, Durham University)

The aim is to provide a series of interlined information retrieval systems that the students must use in order to a) know what is happening on the course, b) see old exam papers, c) read, browse and download documents, d) send in assignments in French by Email, e) do CALL exercises, watch videos and do comprehension assignments -etc, etc, without the lecturer having to run around putting up notices or standing over students telling them what to do. The core course remains based on lectures and seminars, but most of the learning activities are devolved to the students, "empowered" to use the system to their best advantage.

Knowledge testing, language learning, analytical tasks and resume work are all done via networked machines, available at any point on the campus network including residential colleges.

The emphasis on the program design side is squarely on "do-it-yourself" authoring - and the intention is to simplify and demystify courseware construction by language teachers by showing how to convert electronic text into program material and re-present it in a variety of interlinked computer environments using a minimal knowledge of programming.

All the different pieces of software involved will gradually be interfaced with each other, to provide an integrated learning environment. So far, the entry is via GUIDE, but the program links to a variety of other applications, and will include CD databases such as Le Monde, electronic dictionaries, and any of the TLTP language software that is appropriate for the level (final year Modern Languages)

The TLTP Pharma-CAL-ogy Project - strategies and implementation

D. Dewhurst (Faculty of Health and Social Care, Leeds Metropolitan University)
I. Hughes (Department of Pharmacology, University of Leeds)

The Pharma-CAL-ogy project is the outcome of a successful consortium (21 UK universities) bid to the Higher Education Funding Council for England (HEFCE) under the Teaching and Learning Technology Program (TLTP). A sum of £218,000 was granted for 1993/94 and further funding for the following two years was agreed in principle.

The aim is to deliver technology-based, student-centred courseware to undergraduate pharmacology students by: (i) encouraging the implementation of **existing material** by the provision of a **resource centre** and (ii) **identification and development of common courseware** (technology-based) suitable for implementation on a range of medical and science pharmacology courses or modules in different universities.

The **resource centre** contains **fully working copies of relevant pharmacology software** and an **extensive database of technology-based learning materials**. Teachers are funded to visit the centre in Leeds and the centre also travels to UK British Pharmacological Society Meetings. For visitors to London and teachers in the south of England the resource centre is also available at the Wellcome Centre for Medical Science.

Common courseware, written in Authorware™, is being developed at various sites in four main areas; computer-based tutorial material suitable for small-group teaching both staff- and peer-led; self-instructional material (mostly video-based) for use in the laboratory to help students set up laboratory preparations; self-assessment and self-instructional material to help students to have confidence in their independent learning; simulations of laboratory practicals to extend student experience into areas which at present are available only in some institutions which have particular expertise and facilities.

Interactive learning environments on a campus network

F. Arshad, L. Conkar and P. Ward (Information Modelling Programme (IMP), University of Leeds)

The Information Modelling Programme at the University of Leeds is developing general purpose tools and computer-based applications designed specifically for supporting education and training. The acronym SMILE (Supporting Multimedia Interactive Learning Environments) pioneered by the group is the conceptual model underlying our approach, as is the belief that learning materials while being pedagogically sound, should also be attractive and engaging. Entertainment is seen as a means of motivating the user, while the challenge of the interaction arises from the various ways the user may engage with the system. Our approach is user-oriented and concerned with information systems facilitating communication. Systems must be scalable and portable.

Our technological strategy is open systems, informed by the need to accommodate a wide variety of platforms, and to ensure that delivery over a network does not effect the speed and quality of interaction.

The authors will present STILE (Supporting Textiles Industries Learning Environments) , an application developed in collaboration with the textile and colour chemistry departments and, EFC (Environment Foundations Course). Both applications are supporting learning of large numbers of students accessing materials via the campus network. Our development strategy is based on working with experts (who specify content , organisation and communication) and employing techniques for incorporation and creating new means of flexible access in a computer-based model. The courses are now fully operational and the applications are accessible through X11 windows via a client -server model based on the SUN Sparcstation to a number of different platforms (e.g. PCs, Macs, and UNIX workstations) .

The orientation of our technological strategy and application development is led by the need for computer-based systems to be high performance, multi-user, networked and multi-platform. The underlying rational for our work however remains the active promotion of enabling learning technologies.

GROUP 4

Teaching practical research skills:the classification of social interaction in political interviews

L. Allinson (University of Humberside, Hull)
P. Bull (University of York)

Up to now only limited use has been made of the computer in teaching the less formal subject domains such as social psychology. We would argue that one reason is grounded in the technology itself, which until recently has not been an adequate vehicle. The computer has not offered benefits beyond that of tradition methods of instruction, but with the inclusion of video and sound in an integrated teaching environment computer-mediated learning has become a viable approach.

Traditionally the teaching of practical skills in social psychology is extremely laborious, and hence skills of observation, recording and analysing situations and conversations are often only superficially understood by students. Although a number of important categorisation schemes for analysis of social interaction exist, conveying a working knowledge of these schemes is difficult.

One detailed microanalysis of social interaction is the analysis of political interviews. The topology of non-replies (ways in which a politician may not reply to an interviewer's question) has identified numerous ways in which to classify non-replies . As the learning of categories requires learning by example, and is enhanced by recorded interviews rather than just transcripts, the difficulties for the student learner are mirrored by the difficulties of presentation faced by the instructor. This paper will outline our solution to these problems. We will present the motivation for and the implementation of a system designed to aid both the teacher as 'author' and the student as 'active learner'. The paper will discuss the learning outcomes, enhanced by the inclusion of various learning approaches available to the student to choose the nature of their learning . Plans to develop further analysis systems utilising this software will also be outlined. The program is Macintosh-based, and will be demonstrated in order to convey the practical and educational advantages of a computer-aided solution.

From Generation to Generation - separation of content from functionality in interactive language training courses.

P. Bangs (The Language Centre, South Bank University, London)

Authoring tools for language learning have hitherto fallen into one of two extremes - the very rudimentary, although effective, text-based products, or the extremely expensive multimedia systems. Teachers would often like to utilise to the full the new interactive multimedia capabilities, especially sound, which of course has a particular relevance for language learning. They do not, however, have either the time or the expertise to develop the skills needed.

By separating the content from the functionality of the program, we are able to open up the way to the easy creation of sophisticated interactive courseware by non-specialist designers, thus creating materials with sound pedagogic design and which make full use of the latest facilities. So much commercial material, though getting better, is driven by programmers rather than good practitioners of second language acquisition.

The paper will deal with the subject of creating open access language learning materials on a generative basis, exploring the development of the work carried out across various projects - including TLTP and British Rail (Channel Tunnel French programme), and in which we are moving ever closer to our ideal of total separation of content from functionality, using templates created in Authorware. A very short demonstration will show the ease of use of such software routines to create, adapt and transfer materials.

MENTOR: multimedia educational technology for operational research

K. Dowsland, C. Jones and E. Stone (European Business Management School, University of Wales, Swansea)

The MENTOR project is funded under the Teaching and Learning Technology Programme of the Universities Funding Council. The grant was awarded to the Committee of Professors in Operational Research and the project is lead and co-ordinated by Val Belton and Mark Elder, Department of Management Science, University of Strathclyde. The first phase included a review of existing authoring software and subsequent development of the authoring software Learn-OR, and several modules; Introduction to Operational Research, Forecasting, Linear Programming, Simulation and Stock Control.

Learn-OR is a Microsoft Windows based software application which allows authors to quickly create multimedia, computer based learning modules for the teaching of Operational Research/Management Science. It differs from other authoring software in that it is aimed at teaching (rather than presentation). A student using Learn-OR is presented with hypertext, graphics (both still and animated), video and OR technique software packages to enable them to learn at their own pace, and in their own time.

This presentation will focus on Learn-OR, the design of the Linear Programming (LP) module, and current work in the second phase on Integer Programming (IP). The LP module was developed (and is being developed) by Val Belton and Mark Elder, and the IP module by the authors (other modules are also being developed in this phase). The LP module includes an introduction to formulation, the simplex method, sensitivity analysis, duality and a bank of examples. The IP module will include formulation, cutting plane methods, branch and bound methods and a bank of examples. Issues such as navigation methods, use of video material, monitoring and assessment will also be considered.

LOGIFRENCH - French grammar with TestMaster

M. L'Huillier (Department of French, Royal Holloway, University of London)

Logifrench is a language learning program whose aim is to promote the understanding and practice of grammatical concepts regularly used in the teaching of French. Whilst Logifrench's primary aim is to save teachers' time by presenting a wide range of ready-made exercises, authoring new exercises is of course possible.

1. Main features of the Teacher Program.

After loading 'tmt', the Teacher Program, there is a horizontal menu containing File, Edit, Windows and Configure. Selecting Configure from the horizontal menu gives a vertical menu: Function keys should be selected to redefine function keys for accents, etc... Selecting File enables the author to open a file or create a new one. The horizontal menu now contains Edit, Authoring, Windows and Configure. Selecting Authoring gives a vertical menu with the following items:

- Exercise title (to be typed in)
- Items (see below)
- Introduction (to be typed in)
- Help 1, 2, 3 (up to three help pages can be typed in)
- Parameters (see below)

items: for question and answers to be typed in:

- question
- correct answer(s)
- comment
- hint
- wrong answer.

(i) Question box: enter one question.
(ii) Correct answer boxes: up to 4 possible correct answers can be entered.
(iii) Comment box: this will appear on the screen only if one of the correct answers was given by the student, hence it could be a reinforcement. In Logifrench it is the translation of the answer into English.

(iv) Hint box: the hint is for this particular question only, as opposed to the Help Pages (see above), which concern the whole exercise.
(v) Wrong answer boxes: up to 3 foreseen errors, and comments for each of them, can be entered (otherwise, some default answers are available, e.g. 'accents error').

2. Main features of the student program.
After loading a File from the Menu, students get the Introduction (see Teacher Program): this tells them what is expected of them in the exercise. They can then choose between Explore Mode and Exam Mode.

3. Demonstration.
This would include both a demonstration and discussion of Logifrench (and the pedagogical considerations involved) and a demonstration of the TestMaster authoring program.

The Designers NotePad: a tool to support the active learning of writing skills

M. Twidale (Computing Department, Lancaster University)

The Designers NotePad (DNP) is a tool initially developed to support the early stages of software design. Subsequently we have studied its use as an ideas processor; a tool to support the early stages of the writing process involving the generation, organisation and refinement of ideas, the assembling of arguments and the structuring of the parts of a document (paragraphs, sections etc.). The core of the system is a graphical tool enabling the very rapid generation, organisation and refinement of box-and-link diagrams with a hypertext-like features. We claim that an early design decision that the DNP should not embody (and consequently support, but also impose) any particular methodology for undertaking the design process has been important in aiding its generality of application and acceptability. It can support the writing process in a variety of contexts and work styles.

The bulk of the development work has been concerned with refining the interface to make it easy to learn and use and, most importantly, easy to change and experiment with the evolving structures that users generate. We believe that a prerequisite for the acceptability of such a tool is that it avoid problems of prior commitment: unnecessarily forcing the user to decide too early on what the form of the idea should be, by requiring a certain typing or4 structure to be adhered to. If the elements are easy to revise, the user need not worry about their initial form; it can be refined later on. The development process has been one of rapid prototyping coupled with ongoing formative evaluation studies of the use of the system by students from various backgrounds working on authentic tasks (tasks that they had to do anyway). The studies produced an evolving set of requirements for the systems.

GROUP 5

The CLIVE Project : a vet in harness

E. Candy, G. McConnell and A. Short (Faculty of Veterinary Studies, University of Edinburgh)

Developing courseware is like being director, producer, script writer, cameraman all in one. Most academics do not have the time, resources, technical or artistic ability to orchestrate the elements of a CAL production. However, most have a set of slides and a word processing file of course notes coupled with an intimate knowledge of their subject. It was with this premise CLIVE set out to capture and tame the knowledge of subject experts around the country via customisable CAL templates.

CLIVE (Computer-aided Learning In Veterinary Education) is a TLTP collaboration between the 6 UK Veterinary Schools, intended to bridge the gap between academic and computer based delivery providing quality materials to support all areas of the curriculum, with particular attention to clinical areas which are especially under strain as increased student numbers have to learn skills in small groups.

This initiative has highlighted some aspects and inconsistencies of the students. Biochemists have been in hot debate with physiologists about the forces present in a stretched or overstretched muscle and pathologists have compared notes on the incidence of amyloidosis in pigs. Thus the introduction of computer based learning can produce unexpected knock-on effects which help to move towards a richer experience for students and an integrated curriculum.

With a centralised design expertise, academics can develop case scenarios, testing material or tutorials either within the given template or can be helped to develop their own. For example, in case simulations the student can experience the multiple tasks involved in visiting, examining and diagnosing a patient in a visual and engaging way whilst consolidating an analytical and systematic approach to differential diagnosis. Without the pressures of having to implement material academics can be more ambitious, producing less of a home movie and more of a three part mini series!

SPACTeach - Exploring the soil/plant/atmosphere continuum

L. Simmonds, (Department of Soil Science, University of Reading)
J. Schofield (CLUES, University of Aberdeen)

The behaviour of soil water is a core theme in many undergraduate courses in the environmental, land use and agriculture subject areas. SPACTeach was developed out of frustration with teaching the dynamics of water movement in the soil/plant/atmosphere continuum, in which it is difficult to 'bring alive' the reality embodied within a blackboard full of equations. SPACTeach provides the facility to present students with a substitute for 'real world' experience that can be used to explore the factors controlling soil water dynamics.

The philosophy underlying the construction of the package has been to provide a robust simulation model with excellent text and graphic output, extensive user interaction and context sensitive help which is flexible in terms of the level and the context of teaching. Soil water movement is a key process in a wide range of practical problems, including water availability to crops, the movement of pollutants through soil, groundwater hydrology, energy budgets of land surfaces and erosion caused by surface run-off. Hence there is a broad spectrum of potential users for SPACTeach. The challenge was to design a CAL courseware package which could be used at differing levels (from a basic introductory course to advanced post-graduate teaching) and with students with backgrounds ranging from a very limited understanding of physics to those with a high physics content in their courses.

Modifiability as a primary requirement

F. Deepwell and C. Daniels (Department of Geography, Coventry University)

Being able to change the content of computer-based exercises to meet the learning needs of your own student groups has for some time been hailed as one possible solution to the widespread reluctance on the part of lecturers to integrate pre-packaged courseware into their mainstream courses.

Under the TELL TLTP Modern Languages Consortium, we have been able to transform an existing translation training package into an authorable shell which allows lecturers to set up translation assignments according to their own teaching requirements. The resulting shell has evolved from a German package, TIGER Advanced, which has been used successfully in student translation groups for the past three years at Coventry University. Clarity of design and simplicity of use have enabled students using the package to focus less on the computer and more on the translation task. Student motivation is consistently high since the learning environment enables and encourages active participation from the whole group.

The authorable shell currently supports translation assignments into and from English, German, Italian and French. The shell has been designed for lecturers who have little more than basic word-processing skills and allows for a rapid and reliable creation of new translation tasks which can be employed immediately in their teaching. Initial trials of the shell have been extremely well received by both lecturers and students.

Computer Assisted Tutorials: Interfacing teaching, learning & assessment

A. Lloyd and C. Holden (Department of Pharmacy, University of Brighton)

Traditionally, student progression through undergraduate courses has often been based at least partly on formal assessments as these provide a measure of the student's understanding and knowledge of course material. In recent years the quantification of the quality of teaching, learning and assessment has become increasingly important along with the need to monitor students progression at more regular intervals and to provide support material in addition to the traditional lectures, tutorials and practical courses. This paper describes the development of a computer based tutorial system within the Department of Pharmacy, University of Brighton, which aims to provide a means of achieving each of the objectives outlined above through a continual formal assessment process without increasing the demands on academic staff.

The package has been developed using Professional Authorware software in conjunction with the Pharmacy Consortium for Computer Aided Learning (PCCAL) through the HEFCE Teaching and Learning Technology Programme. Professional Authorware provides the opportunity to use interactions, animations and graphics within the individual assessments. This makes for a more interesting package for the student and allows the assessors to test knowledge by more complex interactions than simple multiple choice type questions. Each series of assessments are combined to form a module of approximately 20-30 minutes duration. The selection of questions and the presentation of answers is randomised to reduce collusion between students. Following each assessment the student is provided with feedback on their performance and the correct solution to the particular problem along with any additional information.

This Computer Assisted Tutorial System provides a means of monitoring student progress at regular intervals throughout the course and of assessing the quality of teaching and learning. In addition the system provides opportunities for students to reinforce, extend and revise course material through the self-assessment feedback thereby making assessment an integral component of the learning process.

Enhancing laboratory activity with computer-based tutorials

G. Ritchie (Department of Electronic Systems Engineering, University of Essex)
G. Bloodworth and P. Garner (U.K.Department of Electronics, University of York)

Many students come unprepared into the teaching laboratory - a universal phenomenon! Their efficiency is low and they do not take full advantage of expensive staff time and equipment assets. Students must be enticed to prepare in advance; they would like to be simply given the answers but should earn them in a structure where lecture material is reinforced and they are exposed to methodical procedures. CBL is ideal for interactive learning enhanced by colour and animation.

Our computer-based laboratory tutorials guide electronics students through successive procedures and detail of the experiments, testing prerequisite knowledge and understanding of material as the tutorial progresses. They are guided through the application of theory and handle typical parameter values extracted from data (a skill on its own); circuits and systems are methodically developed from basics through successive complexity. Access to relevant circuit diagrams is provided throughout, as is the ability to flash back to earlier material. On-line access will be provided to the recommended text which is currently being adapted to disk.

Potentially the computer-based tutorial is very compact with the PC / terminal capable of handling extra items such as the experiment scripts itself, reference and data material, calculator, notepad etc in additional windows. Unfortunately a CBL framework has its drawbacks, especially the overhead of expensive authoring time. Even with experience, it is unlikely that one hour of quality screen tutorial can be produced in less then 40 hours.

Running the first of these tutorials has met with unqualified enthusiasm from students and staff. The value is immense, introducing a new structured phase into the active learning process which engenders confidence and competence. As well as highlighting student reaction to the computer-based lab tutorials, this paper will present experiences of authoring electronic subjects in Hypercard and Authorware Professional.

"Work in progress" for the TLTP EDEC Consortium

P. Smith (The University of Essex)
R. Storer (Bristol University)

The Electronic Design Education Consortium (EDEC) is funded under the Teaching and Learning Technology Programme (TLTP) and comprises the Universities of Bristol, Essex, Huddersfield, Kent, Manchester, Newcastle, Oxford Brookes and UMIST. The object of EDEC is to develop CBL material to support electronic design. The consortium is divided into four main themes, Electronic Circuit Design, Digital Design, System and High Level Design, Testing and Design for Test.

The consortium proposes to demonstrate material from all four of the themes, as well as demonstrating the Authorware framework that has been developed to contain the material.

The Electronic Circuit Design theme demonstration will show extracts from four modules of courseware covering the design and use of operational amplifiers. The presentation will also show the use of links to simulation tools (PSPICE) as well as the use of the "EDEC Interactive Laboratory", "Fault Finding Simulation" and "Real Time Simulation".

The Digital Design theme demonstration will show extracts from courseware modules on: Data Representation, Number Systems, Bistables and Finite State Machines.

The demonstration of the framework will show how EDEC authors use Authorware for the creation of material. The major features of the framework are its ability to allow the re-configuration of material within the course module without the need for programming and its ability to enable an adaptive path through material. The framework is developed around a book paradigm, i.e. the module consists of chapters, sections and groups of pages. The page is the lowest level of re-configureablity. The course supervisor can order or remove material from the module at any of these three levels, without the need for editing the course material directly. A paper discussing the development and usage of the framework will be submitted for inclusion in the special edition ALT-J.

GROUP 6

MRP by CAL

H Cather (Department of Mechanical & Manufacturing Engineering, University of Brighton)
M Montekio (Centro de Investigacion en Computacion Educativa, Universidad Anahuac, Mexico)

This workshop demonstrates a Computer Aided Learning (CAL) package developed for both Mac and PCs at the University of Brighton. This package enables a learner, moving at his/her own pace to discover how a Material Requirement Planning (MRP) system carries out its operations.

The CAL package commences with an interactive graphics dismantling sequence to highlight the product structure concept which is the main basis of MRP. During this session the a product is displayed in three dimensional graphics on screen and can be rotated to enable all components to be seen. The dismantling takes place by clicking on the component to be removed. The user then has to construct a chart to demonstrate the assembly sequence. Both the completed product structure and the lead time picture are available to the learner at any time during his session, as is a glossary of terms used during the sessions.

It has further interactive sessions, again with graphics, demonstrating the concept of lead times, at the different levels of assembly. The different costs involved in inventory ordering and holding are also demonstrated and from this the concepts of Lot Sizing, Netting and safety stocks are all covered. The package is designed to be continually interactive during input with text input keep to a minimum, input is often by click-and-drag. Error catching is incorporated with associated guidance messages displayed. A student record of errors is kept during each session which can be extracted for analysis, or simply left for the learners own guidance during the session. The package is designed to deliver between four and five hours of interactive usage without any back-up from staff sources. It has been used on undergraduate and post graduate course.

SYnthia: computer assisted teaching of music synthesis

M. Clarke and S. Hunter (Department of Music, University of Huddersfield)

SYnthia is a CAL package which enables students to learn the principles of sound synthesis and immediately try out these techniques in a controlled environment. Graphic controllers permit students to shape sounds that are produced in real time by a synthesiser (controlled by the programme via a MIDI connection). The package has been in use for 12 months at Huddersfield University, where it was produced, and has significantly increased the quality of learning and the number of students able to take the electro-acoustic option. Several students (as many as there are workstations) can work at once gaining hands-on experience within a carefully controlled environment. Students can work at their own pace, revising material as necessary. The programme assumes no previous knowledge of the subject or of computing (apart from the basic ability to use a Macintosh computer), but contains enough information to occupy even advanced students. The fact that the learning is directly related to an immediate experience of putting the theory into practice make the process more meaningful and therefore memorable.

The presentation will describe the implementation of the programme, describe its use in the teaching situation and the lessons that have been learnt, and outline plans for new programmes building on our experience to date.

The Chemistry Courseware Consortium (C-Cubed)

S. Walker, R. Gladwin, A. Walmsley, T. Drury and R. O'Malley (Centre for Chemistry, University of Liverpool)

This TLT Project is just over half way through its lifetime and its initial products are about to be distributed for the start of the new session. This poster describes the way in which programmers have responded to demands from the community via a courseware design team, the establishment of an acceptable and consistent design interface and formative and summative testing at over 50 institutions. Attention will be focused on the diverse range of institutional deployment strategies encountered and the need for an implementation system that is both informative and completely flexible.

Examples of the project's deliverables will be shown which demonstrate the resourceware concept that has underpinned the whole philosophy. This has led to the production of a portfolio of 'learner tools' which are integrated into all the materials but which can be accessed completely separately under the control of the user. It is intended that these should be used, not only to illustrate the teaching material, but as exploratory probes that can lead the student into a richer appreciation of underlying principles.

The accent throughout is on elementary concepts which have been targeted by the chemistry community as providing the biggest stumbling blocks to students on first entering University. Thus provision is made for students to test their understanding at each stage and the ability for institutions to provide their own material and examples is also provided. Nevertheless the programs are structured such that these may be curtailed or even bypassed completely by more able users.

A multimedia-enhanced CAL package for teaching statistics

D. Jones (Cheltenham and Gloucester College of Higher Education)

A multimedia-enhanced Computer Assisted Learning package is being developed on the Apple Macintosh platform, to teach statistics to undergraduates. The package will be used for independent learning by students who feel their statistical skills to be inadequate for their needs.

Research in the project concentrates on two areas; 1) Methods for formative evaluation of the software during development; and 2) The effectiveness of using multimedia techniques for visualisation of statistical concepts.

The software is being developed using iterative cycles of implementation, evaluation, and change of design. At each iteration, formative evaluation is seen as critical. The project seeks to measure the usefulness of various methods of formative evaluation, and to suggest a framework for the application of formative evaluation techniques. Methods being investigated include: *Observation of users; *Coding of the behaviour of users, based on automatic recording of user input; *Interviews with users; *Completion of questionnaires by users; and *Before and after testing of users.

Summative evaluations of existing CAL packages have shown mixed results. One reason for the failure of some CAL systems to provide effective instruction may be because key concepts cannot be adequately represented using the media available. The addition of multimedia to a CAL package may remedy this problem, by providing new and content-rich media for the representation of knowledge. This proposition will be investigated by using animation and video to present statistical concepts. It is hoped that this will allow students to visualise concepts, so aiding understanding.If accepted, a poster will be prepared describing the current state of the project, detailing preliminary observations on the usefulness of methods of formative evaluation, and the effectiveness of multimedia-based presentation of concepts. The current version of the software will be demonstrated on a portable computer.

Developing and supporting learning strategies for music students

I. Cross (Faculty of Music, University of Cambridge)
M. Pengelly (Department of Music, Lancaster University)

The TLT Programme sets a broad constraint of deliverability which, for the production of courseware for music in higher education, has effectively specified the development framework as a multimedia toolkit. This paper reports how that framework has been found suitable for a broad range of musical domains, enabling the construction of hypermedia environments that can provide a rich resource for investigating factual knowledge. However, when the learning domain has embraced procedural rather than declarative knowledge, the temporal constraint of deliverability has posed problems for software development and structure. These problems have been overcome in the areas where the materials to be dealt with are primarily visual and textual. This is illustrated in areas of musical analysis and notation where it was possible to design interfaces to the packages that incorporated some interpretative function in respect of user input. Nevertheless, further problems are posed with material that is a complex auditory musical signal.

Comprehensively supportive interaction with the user requires the musical signal, as experienced by the user, to be interpreted both at the level of signal processing and at the level of musical notation. The most complex solution requires the development of a computational model of tonal musical structure that incorporates, as formal entities, those classes of phenomena that are operational in the cognitions of the listeners. This solution is not possible within the time span of the current TLTP, although research in this area is proceeding in the UK. We explain the solution that has been adopted in the design of the Aural module. Here limited forms of interaction incorporating simple and heuristic features that can be shown to underlie listeners' cognitive representations are used in such a way as to provide support for the development of those cognitive representations by suggesting and reinforcing appropriate learning strategies.

Project ICPT: developing courseware and integrating computers in physics teaching

P. Jolly (Department of Physics, University of Delhi)

A pilot project for Integrating Computers in Physics Teaching was initiated at the University of Delhi by the author in 1988 with nominal funding from the University Grants Commission. The development work has been shaped by the following precepts:

- focus on pedagogic issues rather than technology;
- choose such problems as are quintessential to teaching- learning of core physics;
- adopt an expansive and holistic approach that can lead to a rethink of the entire curriculum;
- involve students as collaborators in development work, assigning them open-ended projects or specific tasks.

The program is evolving along three distinct but interrelated directions for development of

1. Laboratory Courseware: A variety of applications have been undertaken to set up powerful computer based measurement systems, following a systematic and modular approach to interfacing. Each application package includes the required hardware, menu-driven software and an experiments manual which includes comprehensive details of construction of hardware modules, rudimentary program listings, theoretical background, several experiments reporting illustrative observations, techniques for computer-aided data modelling and analysis, comparison with predictions from theoretical and numerical models, points of significance and finally, exercises and suggested projects.

2. Physics Texts: There is general consensus that physics texts need to be rewritten, incorporating graphing and computational tools in a natural way. We have made a beginning in this direction and are developing a foundation course in Mechanics.

3. Toolkit Programs: These general purpose programs are an extremely important component of the learning environment and provide the basic tools required in the exploration of the subject. Specific examples include data acquisition programs, graphing routines, general mathematical utilities for data analysis and solution of differential equations.

GROUP 7

Computer-based training for mammography

Y. Attikiouzel and P. Jones (Centre for Intelligent Information Processing, The University of Western Australia, Perth)
G. Ritchie (University of Essex)

Breast cancer is one of the major causes of death among women in western countries. An Australian Industry Innovation Program is funding this joint university-industry venture to develop a cancer screening system using a suite of functions to enhance the X-ray images and a computer-based training programme for radiographers and radiologists. A third system will educate patients who are about to undergo screening and therapy.

We need to ensure that mammographic analysis detects breast cancer at the earliest stage possible. This can be helped by better training of radiographers in carrying out their tasks and making best use of the available image enhancement features of this new system. With the expected growth in demand for screening, the current training can be improved by the use of computer-based tutoring technology.

The current experimental diagnosis system is based on Xwindows and illustrates some of the functionality of the enhanced mammography imaging system with more work remaining to be done in assisting the diagnosis stage. The training package has been prototyped using Authorware Professional while the patient education program PEPTALK is still undergoing development.

The prototype radiographer training package runs on a PC and accesses a number of exemplar patients. Each patient has several digitised X-rays and accompanying case notes. This interface presents a similar view to the functional diagnostic system. For example it trains the operator in how to use the zoom feature by displaying pre-processed images at various resolutions rather than doing the computation. Cursors can be placed over the image and measurements displayed. Case notes are windowed and scrollable. The training package guides the radiographer through these manipulations. Comments on the prototype from a chief radiologist and a trainer of radiographers are very encouraging. The entire system will be turned into a marketable turn-key training package by the industrial partner who has considerable experience in the medical electronics field

Integration of a computer-based tutorial into teaching and learning provision in pathology

B. Boullier (Department of Biomedical Sciences, The University of Bradford)

The topic 'Histology of Growth Disorders' has previously been taught to second year BSc and MSc students in our department's Pathology module as two lectures and an associated laboratory class. Class numbers, which will exceed 120 next academic year, previously dictated that this laboratory class was delivered successively to half-size groups. Supervision required a minimum of two staff members and two postgraduate demonstrators for six hours. Students were asked to examine and make annotated diagrams of up to 20 microscope slide specimens of abnormal tissues during their three hour session. Class size severely limited opportunities for individual tutoring. However by this stage of their courses students are familiar with microscope operation and the functional objective of the class is solely to study the specimens provided. Hence adoption of a PC-based tutorial as an alternative to conventional laboratory teaching enables students to remotely study images of these tissue specimens (plus additional specimens that would be otherwise too valuable to release to undergraduate classes) during allocated study time.

'PictureBook' authoring software (V1.42; Digithurst, Royston, UK) was employed to create this computer-based tutorial. Digitised images of tissue specimens, viewable at several magnifications, were combined with pop-up boxes containing descriptive text. To promote and assess learning, students are requested to submit annotated diagrams of selected images. Supplementary sound was considered unnecessary but can be added later. This application is maintained on a recordable CD-ROM disk and is designed to facilitate future enhancement and the incorporation of additional specimen images.

All students will have the benefits of detailed descriptive text accompanying each specimen, no practical limitation to study time, and the continued submission of work for assessment and comment. The advantages to staff are obvious. This approach is a particularly clear example where the integration of new computer-based methods offers many distinct advantages with no apparent disadvantages.

Cardiovascular physiology: an introduction for science and medicine

S. Davies, M. Cornish and F. Bowser-Riley (Department of Biomedical Sciences, University of Aberdeen).

This problem based tutorial package, developed using Asymetrix Toolbook, serves both as an introduction as well as a series of linked revision tutorials for large undergraduate classes in science (ca 400) and medicine (ca 190) It introduces the basic concepts of cardiovascular physiology and is designed to complement ongoing lecture material. The package is highly interactive with animated graphics linked to a series of MCQs and text based questions that require keyboard entry.

The demonstration will discuss the design, evaluation, implementation and adaptation of this CAL based teaching material for use by large classes on different courses.

The production, use and evaluation of an interactive, computer-based haematology teaching package

L. Freeman (Department of Biomedical Sciences, University of Sunderland)
K. Booth (Software Designer, University of Sunderland)

The 'Haematology Guide', an interactive, computer-based haematology teaching package has been produced. The package utilises as a framework video images from a commercially produced laser videodisc.

The 'Haematology Guide' has been incorporated into a Level 3 undergraduate module in haematology. Student and staff evaluation of the package used both as an alternative to laboratory practical classes and as an open learning resource will be discussed along with the developmental work involved in producing the 'Haematology Guide'.

A virtual laboratory for the teaching of physiology

W. Mitchell, G. Brindle and K. Bohme (Department of Computing, Manchester Metropolitan University)
L. Seal (Department of Biological Sciences, Manchester Metropolitan University)

This paper examines the roles that advanced interaction techniques such as virtual reality can play in the development of a learning environment to support teaching in physiology.

Much current teaching still relies on traditional methods such as experiments with animal specimens or the use of diagrams provided in class or in text books. Various factors such as the increase in student numbers, student ethics and the unavailability of specimens mean that the use of animal specimens is increasingly problematic. Moreover a number of physiological processes can only be shown indirectly using instrumentation such as chart recorders when animal tissue is used for experimentation. Also, textbook diagrams are static so that the important dynamic aspects of physiological subsystems cannot be conveyed easily.

At MMU a collaboration between the Departments of Computing and Biological sciences has led to the development of teaching aids aimed at improving the ability of students to conceptualise physiological processes in animals. A multimedia prototype package has been developed which gives students access to the processes and procedures involved in the dissection and preparation of animal tissue for experiments.

A 3D model of a conceptual physiological subsystem is displayed and physiological processes are shown using animation and other graphical techniques. In this 'virtual laboratory' the student has facilities for performing experiments for example using drugs and for observing the results of those experiments on screen.

The results are available both as changes in the behaviour of the 3D model and through the use of simulated instrumentation such as virtual chart recorders. The student can move around the subsystem using portals and can in this way explore the various levels of the world(subsystem).

Initially the neuro-muscular junction is being modelled. It is expected that the lessons learnt from this will allow work in other areas of physiological simulation.

Using the computer to simulate patient cases for medical students

M. Cuttle, P. Hayes and L. Osman (Centre for Medical Education, University of Edinburgh)

At Edinburgh during their clinical years medical students base their learning around patient cases in the wards. Computers are ideal for presenting practice cases to students as the students can:

- be shown simulations of cases not normally seen on the wards.
- practice interpreting signs & symptoms represented by sounds, scanned images and video clips.
- freely discuss the presented case without upsetting a patient.
- afford to "experiment" and make mistakes whilst diagnosing and treating the patient.

Aim: To develop a visually attractive educational and entertaining package enabling students to practice the diagnosis and treatment of a patient.

Method

The case was developed by a team made up of a CAL designer, a consultant and an educationalist. Authorware was used on a PC 486 with a video card and a sound card.

The case presented is a man with jaundice symptoms, and the diagnosis is chronic Hepatitis C. Appropriate sounds and graphics were collected from a variety of sources, for example a chest auscultation sound was recorded live, a drugs company provided a heart beat recording and a medical student agreed to be photographed and represented as the patient.

An accompanying workbook was developed both as a guide to the case study and so as to give the students something to take away with them. A β version of the package underwent formative evaluation by students and independent CAL developers.

In the next academic year a CAL session will be timetabled as part of the clinical student's ward experience and the jaundice case study will be one of a number of CAL packages used by the students.

Currently the jaundice case format is being used to develop a series of orthopaedic case studies.

Posters

The use of photoCD and associated software in biology education

L. Baggott and B. Wright (School of Education, University of Exeter)

PhotoCD is a novel electronic system for the storage and retrieval of photographic images. One CD can store about 100 images, and since the study of Biological materials is essentially a visual experience, the development of interactive courseware based on suitable images is particularly appropriate. This poster describes the trial and evaluation of PhotoCD materials in undergraduate Biology courses, using image enhancement and image management software with an Apple Macintosh microcomputer. Students' understanding, as measured by pre - and post - tests is shown to have improved as a result of working with the PhotoCD materials. Although it is limited to still images, the relatively low cost of PhotoCD opens up new opportunities for educationalists and publishers.

Developing CAL for archaeology: the approach of the TLTP Archaeology Consortium

E. Campbell (Department of Archaeology, University of Glasgow)

The Archaeology Consortium is one of the handful of humanities consortia to be funded by the TLT programme, and its approach should be of interest to others engaged in, or contemplating, computer-based courseware development. The consortium has taken a pragmatic approach to the problems of developing material for an academic subject which has no core curriculum, very diverse syllabi and no consensus on theoretical stance. Development has been directed at specific teaching areas which would offer the most benefit to a CAL approach, rather than trying to offer a complete syllabus in archaeology. The areas chosen were practical work, simulations, key tutorial modules and certain specialist subject areas. Major determining features on the type of product have been the dominance of images in archaeology teaching, the existence of a large body of computer expertise in archaeology departments, and the need for materials to be locally adaptable. These elements have led to the adoption of a fairly high graphics standard for our delivery machines, a decentralised system of module production, and the use of commercial authoring software. The advantages and disadvantages of this approach will be discussed, as well as other aspects of the project organisation.

Promoting active learning through games and simulations embedded in a Toolbook environment

P. Chalk (School of Computing, South Bank University, London)

Courseware must be stimulating, challenging and, most of all, fun to use. The aim of this presentation will be to demonstrate the use of Toolbook to produce embedded games and simulations within traditional hypermedia courseware. The Computing School at South Bank offers a variety of MSc courses in areas including Education (Primary IT and Mathematics oriented) and IT Training and Courseware Development. We have also had the benefit of the experience of the SCALE project, which produced hypercourseware management systems, browsers and training courseware in a Hypercard environment.

One exciting feature of our School is the interface between experienced teachers and IT Trainers on the Masters courses and our Computer Science undergraduates doing their final year projects. The teachers and trainers advise on the design and evaluation of courseware produced by the students who also field trial it in schools and on fellow students. There is a demand for the kinds of games and simulations that have been successful in packages such as SMILE (for school mathematics) and in management training. These appear to stimulate interest in the rest of the courseware and encourage an element of friendly competition and intellectual challenge that is often missing in traditional hypermedia packages.

Courseware demonstrated will include a traffic lights control technology Logo style programming environment; a European Union tourism simulation; a Highway Code training system; a shopping game and a mathematics puzzle.

Discussion will focus on the ease of software development in Toolbook and its robustness; the motivation for embedding games and simulations in courseware; strategies for assessment and individualised level setting; the tension between using Windows standards or individualised interfaces and field evaluations of the software.

Integrating Business and IT learning in computer supported teamworking

J. Gammack and A. Hutchison (Educational Development Unit, University of Paisley)

This paper describes experience gained on running a degree year course in Business Information Technology. The work involved students collaborating in small teams to make a series of decisions using both face to face and electronic communication. Different task scenarios are described, and outcomes are reported and evaluated. Both the technological considerations in running such courses and the wider implications for student learning are discussed.

55 degree year students, (27 male, 28 female, median age 21, were given 5 tasks in all to complete, issued fortnightly. Working in groups of 4 (one of 3) into which they had organised themselves students were required to complete the task and report it briefly (unassessed, for monitoring purposes) by the fortnightly deadline. All tasks required the use both of face to face and electronic meetings. Electronic mail on a mainframe was used to support the electronic meetings.

The tasks themselves were chosen to reflect different types of organisational scenario which would require collaborative decision making and different specialist knowledge. These were as follows:

1) marketing a multi-media product
2) business analysis and operating strategy
3) crafting a corporate mission statement
4) logistics and tendering
5) peer marking

Scenarios 1 and 3 made use of the fact that groups were already virtual companies from the previous term, where they had designed and produced a multimedia educational package. Scenario 2 essentially replicated the "Red Brand Canners study" used by Wild and Winniford, while scenario 4 was based on a management training exercise. Naturally these tasks can be replaced with others, supplied by subject leaders of degree year courses, students or employers: our aim is to introduce co-operative design tasks using multimedia technology developed in the department.

An approach to recursion - using the EROSI tutor

C. George (Department of Mathematical Sciences, Goldsmiths College, University of London)

This paper and software demonstration reports on an investigation into a novel instructional approach to recursion - generally recognised as one of the most difficult topics in learning how to program. This approach, partially implemented in software, is hypothesised to support the acquisition (by novice programmers) of a mental model which will facilitate the comprehension and use of recursion as a problem solving technique in programming.

Recursion is a highly unfamiliar mental activity. Previous research has shown that
(i) novices usually have inadequate mental models for recursion and (ii) existing instructional approaches to recursion have little significant difference in achievement among learners. We propose an instructional strategy

which uses a visualisation technique to allow a learner to form an effective mental representation or model of what happens when recursion is implemented. This strategy builds on and easily extends a learner's knowledge and facilitates the assimilation of new information into existing organised knowledge, by having learners start off acquiring a sophisticated model of subprogram calls, which can then be easily, linearly and readily extended to self referential calls (at which point particular properties of recursion can be taught).

A software package, the **EROSI** (**E***xplicit* **R***epresentor* **O***f* **S***ubprogram* **I***nvocations*) tutor was designed to implement our visualisation technique. Using simulations it shows a simple, consistent process representing what happens when a subprogram is called. Simulations increase in complexity with recursion as the most complex case. The EROSI tutor has currently undergone pilot testing with a few learners who have recently completed our introductory programming course. The results obtained will form the basis for a preliminary assessment of our instructional approach and an evaluation of the EROSI tutor. An OHP and PC + screen projector mechanism will be preferable for simultaneous presentation and software demonstration.

Basic chemistry - interactive problem solving - CAL software.

B. Murphy, C. Murphy, J. Moran, M. O'Leary, B. O'Sullivan, G. Hyde, P. O'Keefe and B. Hathaway (The Chemistry Department, University College, Cork, Ireland)

The software involves l7 l hr. tutorials, 3 Inorganic, 7 Physical and 7 Organic Chemistry, providing a brief introduction to Chemistry. The emphasis in each tutorial is to select a typical numerical examination question, propose a stepwise working method, work through the question, and then repeat the working through, with questions to the student at each step. All the student answers are commented upon, and when incorrect, a hint is provided. After two incorrect answers the correct solution is provided with a detailed explanation. A brief background of the theory to each question is provided on screen, either as a menu choice or as a help button; both facilities can be omitted by the student unless required. The main examination questions are supplemented by a series of multiple-choice type questions (l0-20) related to the topic of the question. These questions are also provided with an extensive help facility, and in some cases are scored (3 for a correct answer, and -l for an incorrect answer), but purely for the benefit of the student. These scores are not recorded. In the Inorganic and Organic sections more factual, rather than numerical, examination questions are involved. In these sections, the emphasis is on a logical connection between the various sections, and the connectivity is emphasised by the use of "spider" diagrams, which can be accessed by clickable buttons. The tutorials are accompanied by one-page handouts for the Physical and Volumetric Chemistry tutorials, containing brief notes, the question, the working method, and a worked answer.

Financial information systems - the development of a conceptual framework.

G. Hill, M. May, T. Aykroyd and B. Kerry (School of Financial Studies and Law, Sheffield Hallam University)

Financial Information Systems (FIS) does not owe its origin to one subject area but rather has emerged from several disparate subjects - Computer Sciences, Information Studies, Management Studies, and Accountancy. Consequently, the area embodied by Financial Information Systems has not previously been developed as a discrete subject in its own right, but rather as a tangential area of all the above subjects. This study will provide a model of the relationship between FIS and it's progenitors and will establish the parameters of FIS as a subject in its own right. A formative model depicting the scope of FIS, and its position regarding related subjects is postulated and a conceptual framework will be developed, outlining the paradigm of FIS.

A review of the teaching of financial information systems in the school of financial studies and law at Sheffield Hallam University.

G. Hill and M. May (School of Financial Studies and Law, Sheffield Hallam University)

Information systems and their associated technology has provided educational establishments with numerous problems regarding what is the most appropriate treatment of the subject for accountancy undergraduates.

These problems have stimulated debate as to:

- which teaching specialism (computer scientists v accountants) is best suited to teach this area
- what is the appropriate split between hands on experience and the theoretical perspective
- which application packages should be utilised
- what is the progression of topics to be covered in each year of the course

This paper provides firstly, an historical perspective by charting the Information Systems route taken by the School of Financial Studies and Law at Sheffield Hallam University in their accountancy undergraduate course. It emphasises in particular the problems faced by the School and the solutions adopted to resolve them. It also describes the integrative nature of information systems and technology throughout the route, and the adaptive role of technology in the student learning experience.

A detailed appraisal of current practice is the main body of the paper, and provides a framework for the teaching of Information Systems to accountancy students at undergraduate level.

The paper concludes with the rationale of a new course to be offered at Sheffield Hallam leading to the qualification BA. in Financial Information Systems.

The Computer Aided Learning project of the Association Of Clinical Biochemists (UK)

J. Hooper, (Royal Brompton Hospital, London)
J. O'Connor (Eastbourne Hospital)
R. Cheesmar (Magic Media Systems, Eastbourne)

In order to aid the education of medical students in response to pressures on the curriculum and reduced teacher numbers, we have developed a prototype computer programme using multi-media techniques. This working prototype is fully interactive and is a clinical case in the field of Clinical Biochemistry. We are using the prototype to define the basic structure of a series of cases intended to represent vital areas of the undergraduate curriculum in Clinical Biochemistry. In order to ensure conformance with agreed educational goals, we have consulted all teaching hospitals in the UK so that we can incorporate appropriate learning objectives within the cases. In addition to the undergraduate case we have also developed a more complex case in the same topic area (thyroid) to aid the education of postgraduate students. Important features of the cases are that they encourage exploration, can assist in interpretation of biochemical data and support decision making. Students can explore different outcomes depending on their responses to questions asked. They can carry through the consequences of making decisions while the harm caused by making wrong diagnoses is demonstrated. Students can work on their own and at their own speed. Evaluation of the student's performance is made by quizzes and also by the way in which the student navigates through the case. The programme can be used as a distance learning package and has international potential.

ELTDORA94 A database of research

A. Hudson (Centre for Mutimedia in Education, Library and Learning Resources, Sheffield Hallam University)

The Centre for Multimedia in Education at Sheffield Hallam University has completed the updating of a database covering worldwide references to the evaluation of interactive technology in education and training. This is a 1994 edition of an original initiative carried out in 1992\93 which produced the ELTDOR database of information on research projects and case studies into the application of interactive technology. The evaluations cover a wide range of studies such as learning effectiveness, motivation, cost benefits and user response. ELTDOR94 contains the latest coverage of such research and has widened its scope, to take in recent trends in education technology both in developed and developing countries.

Use of ELTDOR has already proved invaluable to those who requested the original version. It is presently being used in nearly 600 schools, businesses, training institutions and higher education establishments in 27 countries on 5 continents.

ELTDOR94 will be available free of charge and includes: * details and abstracts of over 800 journal articles, book chapters and reports. * a list of relevant journals, books and newsletters.
* guidelines on searching for further material. * references to organisations and people active in this field.

A document collection for over 600 articles, reports and conference papers is housed in the Centre for Multimedia in Education within the Collegiate Campus library. These are available during library opening hours for reference only, by anyone interested in the material.

Framemaker: an authoring tool for active learning

T. King and B. Slade (Department of Information Science, University of Portsmouth)

In order that students experience cognitive engagement with a learning task, computer-assisted learning (CAL) courseware must provide the tools to encourage the learner's use of cognitive processes. Instructional design should be planned to incorporate a number of cognitive strategies which a student can use to actively and mentally process content in order to deeply learn material. While there are several strategies which are particularly relevant to the design of CAL courseware (viz. concept mapping, chunking, frames, advance organisers and rehearsal) most cannot be implemented from mainstream authoring software. Because of the value of frames and the difficulty of programming them, the Computers in Education Research Group at the University of Portsmouth have recently specified a prototype authoring tool called FrameMaker for creating frames within hypertext software.

By using the windows approach of the MS-Windows generic interface, FrameMaker offers hypertext links between text windows and embeds frames within that text. This paper will describe the learning design principles on which the FrameMaker prototype has been constructed, the features that it offers and future development work. Specific illustrations will be taken from the frames created by FrameMaker for use in the teaching of Information Systems Analysis and Design (ISAD); a subject commonly taught to all first year students on Degree and Higher Diploma courses in Computing at UK Universities, as well as for short modules on Master's Degrees. Certain ISAD topics were chosen as particularly suitable for frame-based learning as they were information rich while in need of a good integrating framework. They were also topics which the students found boring and hopefully could be made more interesting using FrameMaker.

Learning by discovery

R. Lamb (Centre For Planning, University Of Strathclyde)

The principal case study is the first year undergraduate planning class entitled - "Introduction to micro computers" - which is centred around an analysis of the socio-economic structure of the Clydeside conurbation with a particular focus on multiple deprivation. The overall aim is the integration of four software packages - Word , Dbase4 , Supercalc5 and Map91 - into a comprehensive learning experience which closely simulates real world activity . The data is the 1981 and 1991 Census of Population at post code and aggregated post code levels . A real project at a very detailed level -post codes - with lots of variables - at least 10 including population 65+, male and female unemployment , etc., - can be completed because of the enabling affect of the technology . The manual method - i.e. without the software and computer mounted data - is fully described to point up the enabling abilities of the software. The future development of the class will be to include data capture by students via SASPAC in order to fully mirror the real world and give a direct comparison with a non-computer based method.

The prime motivation for the student is this real world replication or simulation. In order for this approach to be successful the data must be fresh , real , and complex. The task must mimic the real world and the students need to see a relevant case study of the approach , data , etc. before they begin the project . There must also be scope to discover something new to the student , and perhaps new in a broader sense through the methods , e.g. by arranging , or sorting , or studying the data .

Supporting IT through the curriculum; a view from Edinburgh

H. Macleod and J. Haywood (Department of Psychology, The University of Edinburgh)

The University of Edinburgh has recently embarked on an ambitious programme to promote the use of Information Technologies (IT) throughout it administrative and academic activities. This poster will present an overview of the ways in which these initiatives have changed and will continue to change the learning experience for our undergraduates.

Ethernet penetrates to most parts of the University, with high-speed connections between its two major campuses. Edinburgh is also participating in the early trials of the potential of SuperJANET. However, these opportunities of themselves will never be enough to convince either students or their teachers of the value and potential of IT, and positive steps are required to foster a climate in which IT skills are recognised as having value in themselves, and in which their potential to facilitate active learning is realised. Interaction between the Computing Services and the academic departments has been the keystone of our programme.

Another key theme has been the *integration* of IT skills teaching into curricula and subject domains, rather than as "bolt-on" adjuncts to the "real" business of teaching and learning. Core skills of word processing, bibliographic search, electronic mail and network information retrieval can increasingly be demanded of their students by teaching departments, to the extent to which they themselves can provide opportunities and support for their students to cultivate these skills. In turn, these new abilities expand every student's potential to engage in active and exploratory learning, while preparing them in important ways for their future careers. The poster will provide an overview of our progress so far, describe some key examples of good practice in the integration of IT use into our courses, and map out the plans for future developments.

CBL and the teaching of industrial design

K. Md Isa (Institute of Advanced Studies, Manchester Metropolitan University)

Teaching and learning in Art and Design, such as Industrial Design, deals with very subjective attributes such as shape, colour, fashion and comfort. It also involves the training in problem solving skills, the refining of students' sense of the aesthetic and the cultivation of good design ethics and values, and finesse of design communication skills. Industrial design learning is primarily aimed towards cultivating and enriching the students' individualistic creativity skills.

The present teaching of Industrial Design is predominantly through the mode of sketches, renderings and model-making. This researcher's on-going PhD research programme is looking into the potential of complementing current teaching with a computers-based learning method that would facilitate a more interactive teaching environment leading to positive discussions and interactions between educators and students. This would be through the use of 3D-modelling which would allow for 'what-if' idea developments as well as quick simulation, testing and evaluation of design concepts.

The computer's on-screen format would be designed to facilitate interaction and communication of ideas between lecturers and students within a scaled 3D-modelling environment. Enhanced further with live-video background and sound, it would ensure reduction in verbal and 2D visual image ambiguity and misinterpretation of the message. The 'scene-sketching' and 'virtual-realism' image manipulation made possible through the use of the computer, would inculcate positive design evaluation skill and improved decision-making by the students. The use of a simulation type of Computer Based Learning could also help the student in detecting potential design problems.

Planner - an interactive multimedia tutorial on project planning

M. Montgomery and M. Bronte-Stewart (Department of Computing and Information Systems, University of Paisley)

This paper describes a project currently in progress at the University of Paisley. The project is known as 'Planner'.

Planner is an interactive computer based learning tutorial on organised thinking and planning of projects. Multimedia technology is used to illustrate and annotate the subject content. The tutorial is a basic introduction to project planning for Learners not already familiar with standard project management jargon and concepts. The tutorial takes a very pragmatic approach to planning and illustrates how we all plan projects in our everyday lives. The tutorial provides Learners with a series of practical stage by stage. A unique six phase methodology is introduced to encompass the project planning process.

The tutorial also aims to provide the Learner with a number of tools to assist the analysis and planning of their projects. High quality graphics, audio, video and animation are used where appropriate to produce an interesting and stimulating environment for the Learner.

This paper discusses the reasons for this projects instigation, the development issues arisen, the practical solutions adopted and the current work in progress.

Using multi media in the learning environment

J. Morris (Halton College, Kingsway, Cheshire)

Halton College has a designated Multi Media team, whose role is to design and produce Multi Media packages for the College and other customers. Staff from all curriculum areas are actively engaged in the production process, producing custom made learning packs, for their own students. A number of packs have already been produced to help deliver part of the curriculum. In addition, packs have been produced for general presentations. Halton College currently uses "TX Authoring" for Multi Media production, along with other graphic and animation software.

The demonstration will outline where the College is at the moment, in terms of how Multi Media has developed over the past twelve months. It will then focus on how Multi Media is to become integrated into the whole College curriculum to enhance the learning environment. This will eventually enable students, who might not ordinarily be able to attend College, the possibility of following a particular course of study, in a more flexible way and at a time that suits them.

The demonstration will also include examples of Multi Media packs, that have already been produced by the Halton College Multi Media team.

PILS: Designing an electronic library for a pharmacology lecture course

A. Ravenscroft, I. Hughes and K. Tait (University of Leeds)

Why do we need PILS ?
The Pharmacology Integrated Lecture Support(PILS) system and its associated methodologies standardise and formalise the preparation, management and organisation of learning materials for a timetabled Pharmacology lecture course. In addition, it allows students to gain control of the delivery and use of the materials. It acts as an 'Electronic Library' that is maintained by lecturers and used by students.

Starting the PILS: Use and Re-use
The design philosophy of PILS follows the principles; exploit IT resources provided by the University networks that are familiar to users or can be learned with little effort, promote the development and implementation of methodologies that can be 're-used' for similar problems.

PILS in Action
PILS consists of a Toolbook interface to a repository of learning materials in Windows and DOS formats .The Toolbook interface is not authored in the conventional sense, but generated using the Interactive Document Compiler(IDC) developed at Leeds. The IDC is a compiler shell that takes marked up text as input and generates a Toolbook application as its output.PILS presents the student with a timetable for the second year Medical, Science and Dental course in Pharmacology. The student simply selects a lecture topic by clicking on the appropriate slot on the timetable and then selects an option that launches the application which delivers the learning material. Hence, the students have a Windows 'work space' that allows them to structure, restructure,

edit or elaborate the learning materials; simply print and down-load the documents, or use additional Windows applications.

More PILS
Using the IDC makes it a trivial problem to generate a PILS equivalent for other lecture courses; and the same document preparation, indexing and software installation procedures can be used. In short, PILS provides a real framework to both initiate and maintain an Electronic Library for any timetabled lecture course in probably any University.

The development and evaluation of a stock control model used in teaching

E. Stone (European Business Management School, University of Wales, Swansea)

A stock control model has been developed, as a part of a teaching package, and used as an integral part of an Inventory and Production Control course. The model incorporates both Fixed Order Quantity and Fixed Period disciplines and accepts variable input for leadtime, demand and the associated costs with in a stock control system. The simulation is run over a period of time, day to day stock levels are illustrated graphically, and an analysis of costs and service levels is displayed at the end of the simulation.

This software has been used as a part of the Inventory and Production Control course for several years, over which various evaluation and assessment exercises have been carried out. As a result of feedback from this assessment, the software has been continually updated. The first area of assessment was directed as to how the students felt that they had benefited from using the software. More recently a further evaluation has been carried out to analyse the understanding of skills and knowledge gained from using the software.

This paper outlines the structure of the model and examines the methods of evaluation and the associated results.

Writing courseware for service teaching in science at Wolverhampton University.

M. Thelwall and R. Binns (School of Computing and Information Technology, Wolverhampton University)

The challenge of the project described here was to develop material for service teaching of statistics to large mixed ability classes. The target was the statistics 1 module with 450 students requiring 10 hours of lectures and 45 hours of tutorials per week, i.e. 3 members of staff. The use of CAL could reduce staff contact time (thus freeing staff for research activities, etc.) Common problems met were low motivation and weak basic maths skills.

Our objective was to provide a new and interesting learning environment where even those students frightened by computers and maths could still learn and enjoy the experience.

We wrote the courseware in self contained units each teaching the material of a one two hour lecture. Each unit is in about 8 separate sections following on from each other. Instead of letting the student browse through the material, we used a mastery learning approach where the student has to demonstrate mastery by correctly answering a question at the end of each section before progressing to the next. The result is that the student cannot misunderstand something and skip over it, storing up problems for a later stage.

The advantage of this courseware over a lecture is that the students work at their own pace so they are learning all the time and don't spend any time either on the one hand baffled or on the other bored. The incentive and fun in the unit come from the colour pictures and sound used as well as the relative novelty of mouse driven hypertext package.

The drawback of the mastery learning approach is that the package is not as investigative as a hypertext package can be. We considered this a necessary sacrifice to help the weaker students who benefit from the step by step approach to mastering what they find complicated and daunting.

Discussion and Hands-on Workshops

WORKSHOP 1 - DESIGNING SOFTWARE TO MAXIMISE LEARNING

Designing software to maximise learning: what can we learn from the literature?

B. Somekh (Centre for Applied Research in Education, University of East Anglia)

This workshop will contribute to the theme on evaluation and quality assessment, drawing on the author's exploration or a wide range of writing on both software design and learning theory.

Issues raised will include:

- whether or not software can be designed to support learners in constructing new mental schema;
- whether or not there is any place for behaviourist stimulus and response strategies in contemporarysoftware design;
- whether games-like strategies can stimulate 'mindfulness' and 'flow' (intense learning experiences) in software users;
- what might constitute the 'right balance' in software navigation between structuring learning and giving users control over their learning
- whether or not software can be designed to stimulate meta-cognition;
- whether software simulations can ever provide the benefits of 'situated learning';
- the advantages and disadvantages of iconic versus linguistic symbol systems for presenting information, and the ability of software to support the process of 'transformation' from one symbol system to another.

Catering for different learning styles

M. Kwok and C. Jones (European Business Management School, University of Wales)

The notion of cognitive styles has gained recognition in the 1950s and 1960s as a significant personal characteristic which raised the understanding of how people learn. Many styles have been identified and reported. Clarke bravely suggested that these styles "differ more name than nature" and "can be classified into either a preference for a reasonable degree of structure and guidance [serialists]... or a preference for considerable freedom to ... [holists]". Clarke's work was based on the 18-item Study Preference Questionnaire (SPQ) of Ford.

We have attempted to test the effectiveness of Clarke's refinement of the SPQ.

The materials used in the study were taken from the multimedia information presentation called the European Business Management School Visual Prospectus developed by one of the authors (MK) as a by-product of this research. It has three operation modes i.e. Self-running, Menu Driven and Fully Interactive.

Fifty eight first year business studies undergraduates (34 female and 24 male) were involved in the second experimental study. Among the 58 students, 30 students (51.7%) were classified to have a holistic learning style; and 28 students (48.3%) were classified to have a serial learning style. They were assigned randomly to either the fully interactive version presentation or the menu driven version presentation; 31 students (53.4%) used the version which suited their learning strategies, and 27 students (46.6%) did not use the version which matched their learning styles.

The authors found a significant difference between the performance of matching and mismatching groups when some of the 'versatile' learners were removed from the sample.

Multimedia: the convergence of formal reasoning and intuitive learning

S. Watters and A. Jagodzinski (School of Computing, University of Plymouth)

Aim: to review models of learning and argue the need for new paradigms in the design of Computer Based Learning (CBL) systems especially Multimedia Learning Environments (MLEs)

Background: Methodologies for the design of CBL systems assume that information is learned through formal reasoning by following rules. Dinsmore has shown that people learn in more than one way; rules based methods are essential for the articulation of knowledge, but learning through experience by recognising patterns in visual input is important as the mechanism through which new objects are recognised. For CBL to be maximally effective both the rule-based and experience-led pattern-matching elements to learning must be considered.

Evidence supporting a pattern-matching element to learning exists in:
a) Educational Theory: Learning is not seen as a uni-dimensional process. Laurillard emphasises the intuitive dimension founded on sensory experience; many scientists emphasise the formal element in terms of mathematical abstractions.
b) Psychology: Learning new concepts and recognising instances of them is founded on a pattern-matching, connectionist process.
c) Neurophysiology: Perception is shaped by patterns stored in memory; context and expectations shape the way visual, sensory input is understood.

Practical Application: An MLE to help medical students diagnose ear, nose and throat conditions. Ways of facilitating learning through pattern-matching (the recognition of visual symptoms) and rules (knowing how to treat recognised conditions) will be discussed.

Conclusion: The design of CBL environments can be improved by the use of techniques which recognise the pattern-matching dimension to learning. Multimedia provides an ideal tool for learning, supporting both visualisation and rationalisation. This presentation will give an agenda for a methodology for the production of MLEs which encompasses both pattern-matching and rule-based elements of learning. This agenda can be applied to all CBL systems.

WORKSHOP 2 - INFORMATION ACCESS

Active collaboration learning of database browsing techniques

M. Twidale, D. Nichols, J. Mariani, T. Rodden and P. Sawyer (Computing Department, Lancaster University)

We report on the first stage of this project; a study of how students learn and use database browsing techniques. This is rapidly becoming an essential skill for all information professionals, including those with limited computational experience. It is clear that much of the learning of techniques for browsing databases occurs informally and opportunistically. Users learn by exploration and experiment and from other users. This is all very good when it happens, but users may fail to learn the more powerful techniques and remain stuck with non-optimal or even incorrect strategies. We are interested in the difficulties and misconceptions that users have and how this knowledge can inform more effective teaching and learner support.

The next stage of the project will use the lessons learned to develop a collaborative learning environment involving mutual awareness of the browsers. That is, rather than in traditional databases where the system ensures that you need not and cannot know what others are doing, in a mutual awareness system you can see what others are doing and how they are browsing. This can be a powerful support to active learning.

The study involves situated observations of students' use of the Lancaster library information systems; the library catalogue and bibliographic databases available on CD ROM. We wished to observe and analyse what novices and more expert users do. This involves looking for recurrent misconceptions, gaps in the users' knowledge, particular areas of difficulty, techniques avoided by users due to complexity, missed opportunities to increase learning, learning skills employed and equally importantly learning skills not employed. We are also interested in social interactions by the database users; mutual help, advice, explanations, watching what others are doing, leaning over screens, sharing keyboards etc.

Time dependent amnesia, intelligent agents and interfaces for information retrieval

J. Core (The Library, The University of Abertay, Dundee)

In a preliminary study of user's experience with CD-ROM based information systems the authors found that the interface provided for the systems were very poorly designed for the task and the patterns of usage found in the user population. The difficulties with the interface appeared to be magnified by users forgetting the procedural and declarative knowledge required to operate the interface.

The authors believe that this problem can be remedied with carefully designed training incorporating advanced technology at low cost. A follow up study using video based training indicated that students can successfully learn and be taught most of the procedural and declarative aspects of operating the interface. However, many still experience difficulty in successfully searching the databases. These difficulties appear to be focused around the selection of search keys/phrases; the construction of the logical connections between the selected keys and the arrangement of these terms in the data fields provided. Thus, the use of *and*, *or* and *not* as logical terms for constructing a search pattern appear to be poorly understood even though examples were given in training. Multimedia based training is likely to be a successful method for preparing users for searching with a specific interface. A follow on study is about to take place in which assistance in the form of single words is given during use of the interface to simulate an intelligent agent suggesting appropriate corrective action to modify the current search strategy. The emphasis is on using simple strategies. The parsing of the search phrase and registration of items found provides the data to guide intervention by the intelligent agent. This should allow the user to effectively operationalize their domain knowledge to conduct an effective search. It is hoped that this technique will allow the user to remain in control of the search in a way that other artificial intelligence methods might not. The approach is aimed at correcting behaviour and not simply coping with inadequate searching behaviour. Thus, the system may result in the development of the appropriate problem solving strategies for conducting effective searches during information retrieval in the long term.

The exploitation of a multimedia platform for delivery of flexible/distance learning materials: a learning technology case study

D. Craig, I. Gunn and A. McCleery (Department of PMPC, Napier University, Edinburgh)

This paper outlines early exploration of and attempts to use a Hypertext platform for delivery of learning materials in a computer network environment.

The explosive expansion of the Internet and the hypertext-based World-Wide Web computer networks from academic and research arenas into commercial and public sectors along with the increased political awareness of the importance of 'Digital Superhighways' are opening up new dynamic possibilities for the implementation and support of flexible learning. The current client/browser software NCSA Mosaic produced and distributed by the National Centre for Supercomputing Applications in Illinois was used to implement the pilot study. This software, which is freely available for Macintosh, IBM, and Unix platforms, enables the delivery of hypertext documents written in HTML (Hypertext Markup Language) which allow dynamic links and in-line graphics. Full-screen graphics, sound and video are also possible with the addition of shareware viewers.

The paper examines the ongoing adaptation of learning materials in three diverse areas: building technology, information science, and graphic reproduction. All three offered particular challenges and opportunities as well as a variety of student users. The software tools were examined and implemented in order to assess their potential for facilitating flexible learning in both a local and global context. In particular, the question of added value through the use of this technology was a constant consideration. A long-standing experience in distance and flexible learning provided a touchstone against which the value of the new means of delivery could be measured as well as an understanding of the environment of intended user groups. Good practice in distance and flexible learning in general was related directly to the appropriateness of the new technology. The paper concludes with a discussion of the future development of the material and the pros and cons of making it more freely available to external users.

WORKSHOP 3 - PROJECT MANAGEMENT

Educational project management; repeat after me

P. Hobbs and S. Price (Department of Economics, University of Bristol)

The literature on computer based learning has focused extensively on questions of educational design and effectiveness. Conversely, there has been relatively little written on how we might improve the design and effectiveness of the physical process of creating CBL material. However, the process by which CBL material is created is as likely to influence the overall contribution of the material as the educational content. In previous papers we have argued that an effective way to improve the efficiency of the creation process is the use of authoring templates which encourage skills specialisation. In this paper we turn our attention to the question of project management in relation to educational software development. We propose a model that provides a route to ensuring a consistent and replicable approach to project management. This model is based informally on the PRINCE methodology, which is widely used in commercial software development projects. The key features of the model, which we call PRINCESS, are the recognition that development is likely to be undertaken co-operatively and in a non-profit setting, that the developers are not a formal team and that management is likely to be on the basis of moral persuasion rather than economic imperative. The form of the model is a set of standard documents, or project management templates, which developers customise to their own requirements.

Geography-cal - another project, another steep learning curve?

F. Deepwell (Department of Geography, University of Leicester)

TLTP Phase 2 came hot on the heels of TLTP Phase 1. The academic community was still reeling from the cultural shift imposed by the requirements of the first round of the higher education initiative. Suddenly the word "consortia" was common currency. After more than a decade of isolated CAL developments, lecturers were now invited to work together, not only within the same institution, but with colleagues from elsewhere.

The project *geography-cal* - a name like many others, forced out of acronym-weary minds - sought guidance and information from Phase 1 developments. Many issues are common to all CAL projects, regardless of discipline, so what has been learnt from past experience? What do students want to be doing when they sit in front of a computer screen? What bores them? What motivates them? Where does "fun" fit into the learning process and is one student's notion of fun the same as another's? Do students want to see "real life" complexity or should courseware be simplified down to the lowest common level of comprehension?

The trend within many TLTP projects is to produce "modules" of student learning to facilitate integration into existing courses. But should the computer module form the springboard for learning or exist as an end in itself? Was this modularity workable in the diverse field of Geography which attempts to explain and interpret the concepts underlying both physical and human phenomena? Before beginning development work on the *geography-cal* project, and with the benefit of consultations with and direct involvement in Phase 1 projects, we sought to resolve some of these issues. Given the short time-scale of the project, our research proved an invaluable starting point for developing prototype courseware.

Developing computer - based business courseware: the Business Courseware Publishing group

J. Aykroyd and G. Hill (School of Financial Studies and Law, Sheffield Hallam University)

This paper considers the formation and development of the Business Courseware Publishing Group and reports on its progress to date.

This initiative came as a result of the authors work in developing computer based courseware for courses taught by the Financial Information Systems subject group at Sheffield Hallam University. The basic premise was that there is a lot of computer based courseware around but it is not being made available to the academic community at large. The major factors inhibiting this include:

- little academic recognition of the work
- no outlet for the courseware once it is developed
- no standards by which to judge the quality of courseware

The Business Courseware Publishing Group was formed to:

- Establish guidelines for the development of high quality computer based courseware for business students in higher education. These guidelines include both teaching / learning materials and model development.
- Enable the sharing of courseware throughout the academic community
- Establish a system for reviewing courseware based on the Group's guidelines
- Provide an outlet for the sale and distribution of courseware that meets the Group's guidelines

The working party comprises members from seven Universities. The Group decided that initially only spreadsheet based courseware would be considered. To date all work has been directed to developing the guidelines and sample courseware.

The paper will consider what has been achieved, provide sample materials and seek to stimulate discussion about this initiative.

WORKSHOP 4. - ADVANCED SOLUTIONS TO COURSEWARE DEVELOPMENT

Horses for courses: selecting tools for cal courseware development

S. Miller, B. Dawson and J. Schofield (CLUES, University of Aberdeen)

Alternatives for developing Computer Based Learning (CBL) materials under Windows 3.1 are evaluated. The main tools assessed are Asymetrix Toolbook, and Microsoft's Visual BASIC, Visual C++, and Excel 5 spreadsheet.

C++ is the tool of choice for professional Windows developers (Over 90% of commercial windows applications are written in C or C++). It is very powerful, but has a formidable learning curve.

Visual BASIC is one of the best selling Windows development languages. VB makes it easy to create Windows programs in a matter of minutes, but has some limitations. The use of DLLs with VB is discussed. There are many third party additions to this popular tool.

Excel 5 uses Visual BASIC for applications (VBA) as a macro language, but will also accept Excel 4 macros. Skills gained in the use of Excel are transferable to and from everyday data analysis. Skills gained in VBA are directly transferable to Visual BASIC. Excel 5 is a powerful graphics oriented spreadsheet. Visual development tools allow an enhanced interface to be produced. It is not possible to produce executable files, so distribution is limited to licensed users of Excel.

Toolbook can be used to produce sophisticated user interfaces. It is well suited to tutorial material that has simple animations and graphics, although it is not well suited to heavy numerical processing. Toolbook is easy to use, but sophisticated applications require programming. It has a unique programming language that is simple, but requires some investment of time to master.

Examples of CBL applications developed by each of the above tools are discussed in the paper. Ease of development and subsequent product maintenance are addressed. All the tools discussed have toolboxes, from which objects are selected. Attributes are attached without regard to how the selected objects perform their functions. This allows each tool to develop interfaces of a similar degree of sophistication. The tools differ in their learning time, the efficiency of resources used (physical storage and memory), and their suitability for numerical processing. A comparison is made between an application prototyped in VB, and the same application written in C++ at a similar level of functionality. The paper classifies the tools, and attempts to relate these to different categories of CBL that may be produced by them.

Authoring with Visual Basic.

C. Jex (Management Science Department, Lancaster University)

The objective of this session is to illustrate the advantages, in terms of flexibility, productivity, and product support, of using an advanced general purpose language for authoring, particularly where mathematical and graphical facilities are important.

VB combines the power of designing interfaces by 'visual programming' with features like multi-dimensional arrays and recursion for mathematical calculations. It gives relatively painless access to the Windows API for advanced applications and yet is well suited to the needs of the non-professional programmer.

Support for VB is extensive - there are books at all levels, most including discs of example code which are useful applications in their own right. 'VBX' files provide a wide range of special features which can be added to any VB project - e.g. business graphics, spreadsheet emulation, data acquisition, etc...

The future of VB is assured as a central plank of Microsoft's software strategy. 'VB for Applications' is to be the common macro language for Microsoft's major applications and the implications of the new OLE 2 are truly revolutionary for software developers. Some examples using MS Excel objects will be demonstrated.

CBL applications developed in VB for the TLTP Statistics Consortium and the MENTOR consortium will be demonstrated, including examples of controlling MINITAB from within a VB program, using MS Write as a student report file, use of recursion, graphics and spreadsheet emulation.

The Expert System Shell as a courseware tool: experiences in law and medicine

S. Hand and V. Looney (Department of Information Systems, Portsmouth University)

Expert system shells are an under-used courseware tool. This paper reports on experiences in producing a range of CAL courseware in law and Oncology. Numerous packages have been constructed using both the expert system shell XiPlus and the hypermedia package Toolbook, separately and in conjunction. The latter technology has many advantages in terms of delivering a lot of information in a user friendly manner.

However, the expert system shell has advantages in the interactivity offered, especially in areas where the material to be learnt is to do with decision making. The resulting courseware can be used in a variety of different modes - for example, to show how an expert would arrive at a decision from a user-derived case or to present a case study to the user and then to compare their decisions with the systems approach including: it is making the decision itself; it is able to deal with a multitude of different routes through a case study; it is very fast for prototyping the system. User feedback has been very good for the courseware developed in this way in both domains, and in some cases the users have preferred it over hypermedia systems.

Potential disadvantages in using a shell like XiPlus are firstly that the author needs to become familiar with the way the technology works (e.g. backward chaining) and secondly that the interface, although adequate, does not compare with the best that can be delivered by a specialised interface package such as Toolbook. This is offset partly, however, by using a platform such as Windows allowing the two technologies to be used in tandem.

WORKSHOP 5 - DEVELOPING AND EXECUTING A DEPARTMENTAL POLICY FOR USING LEARNING TECHNOLOGY

The Bionet teaching & learning technology programme: changing the pattern of teaching in biology & pre-clinical medicine.

F. Bowser-Riley (Department of Biomedical Sciences, University of Aberdeen)

The BioNet project aims to introduce or extend the use of information technology (IT) in 52 Biological Science and Preclinical Medicine courses (enrolment 6,000 students) in 17 universities in the United Kingdom. Given the projected growth in student numbers and the intention to enhance the quality of teaching provision, BioNet's objective is to create successful courses that make integral use of IT to increase teaching efficiency. At the heart of this project is the assertion that the present limited implementation of IT-based learning within universities is not a consequence of lack of technological innovation but is more closely associated with increased workloads, timetable pressure, reduced resources, resistance to new approaches and lack of recognition for the effort involved.

The three lead sites are the Department of Biochemistry and Molecular Biology at the University of Leeds, the Department of Biomedical Sciences at Aberdeen University and the School of Biological and Medical Sciences at the University of St Andrews. Prominent in previous initiatives in computer-based teaching, the groups at Leeds and Aberdeen have both been awarded IBM prizes for their work, and St Andrews brings to the project an expertise in multimedia development on the Apple Macintosh. Managed from Leeds, the project links these lead sites into a network of departments that share a common urgency to transform their patterns of teaching.

BioNet is an exciting project which could effect real changes in the way that biological and biomedical subjects are taught within UK higher education. The object of this presentation will to be discuss how this can be done and to summarise the current progress of the BioNet consortium.

Case study of the use of in house developed multi-media learning technology within the Division of Science and Engineering at LJMU.

R. Lees, D. Phipps, B. Lisewski and P. Raby (Department of Biomolecular Sciences, Liverpool John Moores University)

The case study will describe the use of multi-media courseware within two existing courses in the Division of Science and Engineering at Liverpool John Moores University. The courseware was developed in - house, and has been used within a 9 week module entitled 'Biochemical Methods'.

The courseware was evaluated with two separate groups of students. The first group were first year part time HNC students, whereas the second group were second year full time degree students. Student access, prior knowledge and student expectations were very different for the two groups.

In the workshop we will show how the courseware was integrated into the existing course as a means of enabling active learning. We will highlight how and why the courseware was used in different ways in order to meet the different student needs and prior learning experiences. Student feedback has allowed us to evaluate the motivation of the two groups of students, and their preferred methods of learning.

After a brief outline of the case study, we intend to open the workshop to include the views and experience of other participants, and to develop a discussion on appropriate delivery strategies for computer based courseware. We would therefore welcome participation by anyone who has experience of implementing multimedia learning technology.

Adopting learning technology - responses to the imperatives.

R Ward (Department of Economics, Salford University)

We report on the processes by which a university department has come to adopt aspects of learning technology - CAL/assessment packages for the teaching of introductory economics. The emphasis is on responses to imperatives - coping with increased student numbers, given limited resources; providing a stimulating learning experience; improving the quality of education provided. We hope that one department's experiences and its responses can reflect the current problems which many university departments face and illuminate the pitfalls and opportunities which CAL affords.

We examine the background to the current situation, how the traditional modes of teaching have broken down - rising students numbers per member of staff, coinciding with increased emphasis on research publication resulting in less staff time available for teaching; increases in the numbers of students coinciding with lower qualifications than in the past; developments in secondary education resulting in changed expectations amongst potential students in terms of undergraduate studies. CAL and computer-marked assignments seen as a potential route to the resolution of these questions.

It is argued that all these imperatives point to the need for radical solutions, such as those associated with new technology. But more than this, the educational and employment needs of current students are such that these are the very students best suited to gain from these new technologies. We therefore search for the most cost-effective ways to implement these techniques. These we currently identify as the adoption of a commercially available CAL package associated with a leading introductory textbook and of the open-content Question-Mark package. But the most important point is that these adaptations will change what is offered - and ultimately it is only if these changes offer educational improvements that they should be adopted.

WORKSHOP 6 - SUPPORTING LECTURERS IN THE PRODUCTION OF LEARNING TECHNOLOGY RESOURCES

Project LoCAL - a low technology approach to computer based learning courseware development

J. Tidball, J. Milne and S. Heath (Centre for Computer Based Learning in Land Use and Environmental Sciences, University of Aberdeen)

There is a growing demand by lecturers for computer-assisted learning techniques to enhance courses throughout education. However, even with the emergence of powerful new courseware development tools such as Toolbook and Authorware, computer-based courseware is still relatively costly to produce and usually requires lecturers to acquire new skills. The **LoCAL** approach addresses both these issues by developing a methodology which will enable educationally effective and visually stimulating courseware to be produced with the new generation of standard Windows application software. The recent advances of modern spreadsheet and word processor tools allow a *low-tech*, low-investment route to courseware creation which builds naturally on skills now common among lecturers. Once augmented by customised Help, which is also easy to create, the outcome will be pedagogically rich and self-supporting courseware. This approach will enable the resource-efficient creation of computer-based courseware which meets local teaching needs but is also transportable between institutions. We believe that the effect will be to enhance the current use of computers in the classroom and enable the production and implementation of new courseware to become a more mainstream activity for lecturers.

The design of small CAL projects, with reference to LoCAL

A. Hamilton (Department of Construction and Surveying, University College Salford)

Theme

Much CAL design theory relies heavily on theories of learning and psychology; thus those developing CAL with limited experience and resources may not attempt the onerous task of mastering this complex body of knowledge. This can result in poorly designed and ineffectual courseware. The remedy is to understand the needs of those who are non specialists in CAL and to set up a supporting environment for them. This is one of the aims of LoCAL. This supporting environment is to be both human (workshops, telephone support, and email conferencing) and material (written guides and examples of good practice.)

Design appropriate to small scale modelling

What do those working independently on LoCAL need? This can be determined from two sources: i Analysis of LoCAL conference returns. ii Reflection on the five year Educational Support Grant project in Manchester to support teaching staff in producing courseware.

- Design is seen as four elements. i the domain model. ii. The educational model iii Interfaces iv. Narrative and continuity.

Implementing the design

- Importance of portability in LoCAL (i.e. avoiding not invented here syndrome). Documenting the CAL to make it portable - i.e. aims and objectives, target audience etc.
- Recognising the difference between implementing large scale and small scale projects.
- Deriving a design implementation methodology that can be easily adapted to the context of the designer.

How design fits into the LoCAL strategy

- Technical considerations. The chosen software, Excel, is cheap to education, already has a large user base, runs on IBM and MAC and has the weight of Microsoft behind it.
- The LoCAL partnership in HE. A model for gaining the acceptance of CAL in HE.
- How design, technology, and partnership, are integrated in LoCAL.

Supporting staff: the vision and the reality

H. Khan (Hypertext Support Unit, University of Kent)

The Hypertext Campus Project is a single site, TLTP-funded project, based at the University of Kent. One of the aims of the Hypertext Campus Project was to create a specific unit, the Hypertext Support Unit, responsible for promoting the pervasive use of hypertext through staff development and support.

This presentation will discuss the strategies of the Hypertext Support Unit on publicity and promotion of hypertext, and on supporting staff. It will also analyse the effectiveness of these strategies, and look at the reasons for their success or failure. The adoption of new approaches will also be discussed.

One of the most successful strategies has been to provide workshops for training staff. The Hypertext Support Unit's role is to help enable staff to promote active learning among their students; therefore, training was perceived as very important. This has proved correct; the workshops are well attended and have generated much enthusiasm about the use of hypertext in teaching and learning, as well as providing staff with the confidence and technical skills to begin to author hypertext applications.

Some strategies proved less successful, and needed adjustment. The Hypertext Support Unit offered to support staff by developing applications for those members who felt that they did not have the time or skill to author hypertext for themselves. However, in reality it was recognised that if staff members did not retain some sense of interest or ownership in the application, then they were reluctant to promote it to their students. As a new approach, the Unit recommends that the staff member reviews the work at each stage of development, and plays an active role in creating the finished product.

HANDS-ON WORKSHOPS H1 AND H2

Introduction to microcosm - hypermedia for resource based learning in Higher Education

S. White and P. Maier (Interactive Learning Centre, University of Southampton)

Microcosm is an open hypermedia system developed at The University of Southampton. It is being used by the Scholar project to provide a flexible, resource-based multimedia learning environment through which academic staff can readily create, reuse and customise learning materials to suit their own teaching requirements. In the context of using open hypermedia systems for teaching and learning we are particularly interested in examining the use of resource based learning within higher education, and the inter-relationship between the conventional approach to resource based learning and the novel use of hypermedia in this area.

This hands on workshop will introduce the novice user to Microcosm through a basic set of exercises. Each participant will be provided with an open learning handbook with information to make the user a proficient and active reader of any Microcosm application.

The use of KnowledgePro for Windows for CAL

N. Ford (Department of Information Studies, Sheffield University)

KnowledgePro for Windows allows the seamless integration of:

- hypertext
- rule-based programming (IF... THEN... rules)
- object-oriented programming (including inheritance, class objects)
- multimedia
- database management (including image handling)
- and offers facilities for:
- compression
- automatic generation of C++ code
- royalty-free distribution

Liberal use of default parameters enables shallow early-learning curve.

In the workshop, participants will write a CAL package entailing the integration of:

- hypertext
- graphics with hyper-regions
- IF.. THEN.. rules
- user questions and evaluation/use of answers.

Papers

The conceptualisation cycle: a framework for ALT

J Mayes and L. Coventry (ICBL, Heriot-Watt University, Edinburgh)

This presentation will outline a framework for understanding the relationship between varieties of ALT, and stages of learning. Our basic description of learning is of a cycle of conceptualisation and re-conceptualisation, a process of iterative refinement of understanding. There are three fundamental components:

- Conceptualisation- the contact the learner has with other peoples' conceptualisations. This involves an interaction between the learner's pre-existing framework of understanding and a new 'exposition'.
- Construction- the application and testing of developing conceptualisations in the performance of meaningful tasks.
- Dialogue- the creation and testing of new conceptualisations during conversation with both tutors and fellow learners, and the reflection on these.

Each component is then expanded into a similar cycle. The analysis of learning places greater stress on the need for learners to perform meaningful tasks, and for the resultant understanding to be reflected on, and discussed with others, than on the 'primary exposition' - the explanation from which the learner forms an initial conceptualisation. This contrasts with the prevailing view, both in the choice of methods of the higher educational system, and in the assumptions of the multimedia industry, that the main contribution of technology is to present the primary exposition in an interactive and enticing form.

We distinguish three kinds of learning technology, distinguishing between delivery of content, tools for doing learning tasks and technology for supporting dialogue

The implications of this framework for relating ALT to a model of learning will form the second half of the presentation. Implications for the development of ALT in the direction implied by the conceptualisation framework, will be examined both for educational policy and for research opportunity.

Interactive computer-assisted reflective learning

J. Cook (School of Technology and Information Studies, Thames Valley University, Ealing)

In this paper we present a brief review of current research on reflective learning and teaching with computers and a discussion of the meaning of reflection in a learner-teacher context. However, it is not clear what theoretical framework should be use as a basis for building interactive, computer-based learning environments that aim to encourage reflective learning. For example, in John Self's proposal for a four level framework prominence is given to science-like problem solving. We claim that an emphasis on 'problem seeking' is crucial in open-ended domains, like music, where there is no right or wrong answer. Furthermore, we assert that computer-assisted reflective learning environments should shift their emphasis from encouraging a learner to be reflective about domain knowledge to include fostering a learner's ability to be reflective about their own learning.

We support our assertion with a discussion of some work on 'self-explanations' by Bielaczyc and Recker. We present our extension of Self's framework. Protocol studies taken from the domain of music were used to demonstrate where we can and cannot assign activities to the different levels of our framework. Only in one instance (John Sloboda's protocol of himself composing) do these studies provide the level of detail required to clarify aspects of our proposed framework. In particular, the link between teaching intervention and reflective learning requires further study. Some practical guidelines for creating and studying reflective learning-teaching situations are proposed.

Evolving principles of performance support

P. Barker and A. Banerji (School of Computing and Mathematics, University of Teesside)

In his systems map of the Universe, Checkland identified five fundamental types of system. Of these, one of the most important is that involving human activity. A human-activity system is one that involves people doing things either individually or in groups in order to realise agreed-upon objectives.

Within any given situation the realisation of objectives is intimately interwoven with the concept of 'performance'. Performance describes how well an individual (or group) can perform a task (with or without the use of support tools) within a given application domain in which various constraints may be prevalent. The study of performance support is therefore concerned with: the specification of performance criteria; the formulation of performance metrics; the measurement of performance; and the provision of appropriate job support tools and performance aids. The tools used in a performance support environment must enable individuals and groups to improve their efficiency and effectiveness with respect to the successful fulfilment of task-related activities.

Electronic performance support (EPS) is concerned with the provision of computer-based facilities in order to enhance task performance, and hence, the productivity and competitiveness of an individual or an organisation. Fundamental to the effective implementation of an EPS facility are: (1) the design of suitable mechanisation and automation tools to facilitate task performance; (2) the provision of task-related information at particular points of need; and (3) the use of suitably designed just-in-time training procedures in order to overcome knowledge and skill shortages within a task-driven system.

Over the last five years we have been studying the use of electronic performance support tools within many large organisations - both academic and commercial. Arising from this study a number of basic design guidelines and performance support principles have emerged. In this paper we describe these principles and guidelines - illustrating their use by means of a number of case studies involving the various EPS systems that we have built.

Designing interactive multimedia applications for flexible learning strategies

R. McLeod (Development Officer, Grampian Region Education Department, Stronsay Drive, Aberdeen)

The paper will cover a number of key issues with regard to the design of interactive multimedia materials. The term "multimedia" can cover a range of new technologies, but this paper will focus on those applications which make use of full-screen, full-motion video i.e. interactive video, and most recently, CD-I.

What is interactivity?

Various levels of interactivity have been defined ranging from the lowest level using, for example, touch screen systems for public information services, to the much higher level where the user can control the nature and the pace of the learning, can input responses and receive feedback. It must, of course, be realised that applications with a low level of interaction may be perfectly appropriate and effective in certain situations, while some applications with a high level of interactivity may not always achieve their goal.

Designing for interactivity

The paper will refer to specific IV and CD-I applications and will describe how the learners' needs have been met by various technological solutions:
"Strathlethan" (Grampian Region Education Department): An in-house IV production which proved the viability of creating relatively low-cost, yet sophisticated training materials aimed at headteachers in primary schools.
"Higher Grade Physical Education" (Scottish Office Education Department and Grampian Regional Council Education Department): The most recent "state-of-the art" IV production in Scotland, aimed at introducing teachers and students to the new Higher Grade course in Physical Education.
"Skills for Appraisal Interviewing (Primary)" (Scottish Office Education Department and the Scottish Interactive Technology Centre): the very first full-screen, full-motion training application on CD-I.
As designing for interactive multimedia involves the merging of several areas of expertise (video production, publishing, design, computing, knowledge of flexible learning strategies etc.), the paper will discuss how these areas can contribute to the creation of effective teaching and learning materials.

Method of presentation
Because of the use of IV and CD-I technology, this presentation could be delivered either as a discussion workshop with a maximum of 20 participants, or as a presentation to a much larger audience if BARCO or other similar data projection facilities were available. The presenter would be able to provide the necessary IV and CD-I hardware if required.

Teams, technology and knowledge: A strategy for optimising the environment for organisational learning.

D. Anthony Wilson (School of Business, Oxford Brookes University)

This paper describes early research and work in progress being undertaken by the business information system lecturers at Oxford Brookes University School of Business. It focuses on the 'learning organisation'

The paper is in three parts: first **a review** which defines the learning organisation, and outlines objectives, theory and leading edge practice in Europe and America. Then a **theoretical analysis** of the internal environment required if a learning organisation is to flourish, and finally a description of **research in progress** to quantify obstacles to the development of learning organisations; to chronicle examples of workgroup computing in UK learning organisations; and to propose strategies to optimise the internal environment for the learning organisation.

The review briefly summarises the origins of the learning organisation concept in the UK (Revans, Burgoyne, Pedler et al) and in the USA (Argyris, Schon, Senge et al).

The theoretical analysis describes characteristics which in theory affect the required internal environment, and categorises them as blocks, enablers and drivers. Blocks must be removed if progress is to be made: typically these are negative aspects of hierarchy and culture. Enablers will ease the development of a learning organisation: examples of these are suitable technology and adequate mutuality. And drivers are essential to get the process going: important amongst these are empowerment and commitment.

The research in progress at present focuses on two areas: the use of groupware for ad hoc project groupings, and a search for strategies to remove the most important blocks. During the next stage we intend to chronicle best practice in a cross-section of flatter organisations.

Specification and Implementation of an `Active Learning' facility

R. Boyle (School of Computer Studies, University of Leeds)

We observe that the trend toward `active learning' has growing momentum, and identify that it is hindered by a shortage of suitable accommodation; in particular, traditional rigid, raked theatres inhibit rather than encourage imaginative use. Accordingly, a specification for an alternative form of accommodation -- an `Active Learning Centre' -- is given.

The establishment of special purpose facilities is, in the current HE climate, usually a political minefield, and a case study is presented of the establishment of an ALC within the University of Leeds. We document the campaign toward its establishment, and the procurement of accommodation and `fitting out'. We consider issues of specific equipment and capacity versus floor space for particular uses. Feedback from users (staff and students) is given to provide judgement on the experiment. Some general conclusions are drawn to assist others who may be planning similar developments.

Case study: Sainsbury's evolving learning technology

D. Hawkridge (Institute of Educational Technology, The Open University)
L. Houldsworth (Henley Management College)

This paper provides an example of a company's innovation adoption curve for learning technology. It traces an evolution, in a large UK retail company, from mainframe- to PC- to multimedia-based training. Since the mid-1980s, Sainsbury's has met staff training needs in part through learning technology, piggy-backed on new IT-based retail systems. As these systems have evolved, the company has made complementary advances in learning technology in its progress towards a wholly integrated, electronic supply-chain management system.

At the outset, the mainframe at the heart of Sainsbury's retail operations provided training via in-store terminals and the company developed programs with the PHOENIX authoring system. Tutorials were highly structured, offering drill and practice. Despite their general success - for example, after installation of the ACCESS retail system, calls to the help desk were few - the PHOENIX programs became out-dated, with their two-colour presentation and linear page-turning interface. As part of a major change in overall IT strategy, the terminals were replaced and each store now has seven PCs, capable of providing multimedia and icon-based displays. One is in the training room. These are networked to an HP-9000 mainframe linked to the retail systems mainframe at Blackfriars in London. IconAuthor is the authoring system; it offers more flexibility including graphics, colour and animation. Sainsbury's is taking the next step now by experimenting with multimedia, on CD-ROM, with video clips and sound.

When trainers prepared the PHOENIX software, they had to work to the level of the weaker trainees, relying on separate workbooks to provide different levels of training. This caused frustration among the more able trainees, who tended to skim through the material. The image of computer-based training via PHOENIX thus became tarnished, but trainees like the new IconAuthor-generated software. Evaluation of individuals' progress, impossible under the old system, is now feasible, and trainees can print off their own records of achievement at any time.

Successful implementations of CAL in Dutch higher education

M. Mirande and M. Leiblum (Institute of Research into Higher Education, University of Nijmegen)

To help categorise the various stages of computer-aided-learning (CAL) usage in higher education, five can be identified: 1) complete unfamiliarity, 2) orientation, 3) introductory, 4) regular and 5) integrated usage. Many faculties now find themselves somewhere between stages 3 and 4, which is characterised by sorting out or establishing policies, creating budgets, finding a co-ordinator and developing an implementation scheme or protocol. For help at implementing CAL during stage 4 we use the metaphor "hitting the bulls-eye" to identify four important impact points.

The first is to clearly recognise the critical success factors that normally accompany effective CAL usage. In total we identify 11 factors that can be divided into three hierarchical levels: the strategic, the organisational and the operational level of an educational institute. On the basis of an investigation, those responsible can uncover in which part(s) of an organisation are the conditions ripe for the most successful implementation.

The next step would be to place the target, e.g. project type most likely to succeed, in the most appropriate environment. An enquiry can be held among all teaching staff involved with the curriculum that has been identified as most propitious. Questions to be included in the inquiry should be rated on six criteria. The higher a particular course component scores on these criteria, the more likely it is to become chosen for a CAL solution.

The third step is to follow the experience of the master; those who have already made successful usage of CAL. 21 successful applications of CAL have been collected in a book titled "The Merits of CAL". Therein it appears that in higher education, CAL is successful in five different ways.

The fourth point is to continue trying until the shot has hit the bulls-eye. This can be seen as a form of quality control or fine tuning of a product with special attention to didactical and content needs in the program under development.

Support of learning using an architecture for CSCW for engineering design

J. Gammack, D. Jenkins, S. Kydd and S. Tian (Department of Computing and Information Systems, University of Paisley)

The authors are involved in the DTI CSCW programme as academic researchers in the Designers as Users of Collaborative Knowledge in which a workstation architecture is being specified based on video, audio and pen computing techniques. The workstation will support interactive design conferences and meetings by allowing a participant to observe the faces of the other members of the conference in addition to working collaboratively on a shared design journal. The design journal has the property that hypermedia links are built between the pages of the journal as the participants work. In the design context, these are to be used to propagate constraints, enable design reuse, &c. But, in addition, the workstation will collect the protocol of the design conference and techniques are being developed to allow Knowledge

Sources to respond to this protocol to create an open "Whiteboard" architecture, the name being chosen to highlight both the similarities to and the difference from the use of the "blackboard" in AI work. Since design and learning are related human activities it is thought that this architecture could be used to support tutorial and seminar work in active learning where this is mediated over a distance. The teaching version of the workstation will build upon experience with a group of architects and office workers in using applications supported by the Multi Media Toolkit for Cooperative Applications, the product of a completed ESPRIT project. This experience, and its impact on planned experimental work with students will be discussed. The selected technical basis for the workstation will be presented; at present the use of fractal compression and CD-ROM archiving of protocol are key elements. Models for the use of recorded protocol in quality assessment and the like will also be mentioned.

The implementation of a multimedia learning environment for graduate civil engineers.

C. Smith and P. Jagodzinski (School of Computing, University of Plymouth)

The paper examines the underpinning theory, design and implementation of a computer based multimedia learning environment (MLE), for graduate civil engineers. The first phase of the project elicited a wide range of knowledge in the problem domain, and characterised it by mapping it onto a number of different knowledge representation paradigms, namely: symbolic/formal, experiential and metacognitive.

The paper describes the approach used to convey knowledge to the learner so that it can be seen in terms of: (a) its atomic conceptual elements expressed in formal terms, (b) intuitive knowledge based on visual patterns, (c) the underlying theoretical connections, (d) the metacognitive strategies needed to apply the knowledge

A framework of presentation was needed to enable the trainee to acquire patterns or scripts consisting of, for example, at a high level, the phases of a project life cycle as used in industry and, at a lower level, the engineer's procedural knowledge, both of which are used throughout a project. This was accomplished by using the 'Cognitive Apprenticeship' model of learning which situates all the knowledge necessary to solve a problem within the context of a simulated mini project. Working through a project in this way encourages the learning of metacognitive strategies and promotes a deeper understanding of the other types of knowledge, seen in a variety of contexts.

Initially, the solution to the whole problem is Modelled and explained, in detail, step by step. The learner is then encouraged to take on parts of the task for themselves and Coaching is provided i.e. hints, guidance and feedback. The system's support for the learner, that is, the amount of Coaching provided (termed the Scaffolding) is slowly Faded away. Additional elements such as the learner Articulating and Reflecting on the problem solving are introduced and, finally, the user is propelled to Explore solo problem solving. The reference and training facilities offered to the user by the MLE are explained with examples. The Cognitive Apprenticeship model is most evident in the Coached examples module which is explained by discussing the underlying architecture and workings of the module. This includes: the pedagogic rules for operating the cognitive apprenticeship model (i.e. deciding what should be faded next and how to offer help, articulation and reflection); the student model (for evaluating and keeping track of the elements understood, and their depth of understanding, by the trainee); the civil engineering domain rules (used to check students' work and provide assistance).

Enabling active learning through technology in higher education: issues for designers and users

R. Macredie (Department of Computer Science, The University of Hull)
P. Thomas (Department of Computing, The University of the West of England, Bristol)

There is an increasing interest in the use of technology-based materials to support active learning in Higher Education (notably through projects under the current TLTP). This paper will examine two of the factors that are likely to impact on the successful adoption and, perhaps more importantly, spread of such learning materials: the effectiveness of the materials, and the socio-political dimension of HE. We will suggest that both of these issues have to be addressed if technology-based learning is to become widely accepted and used.

This paper will briefly discuss issues impacting on the effectiveness of materials, and will suggest that an understanding of the core instructional issues and the ways in which they may be interpreted and applied in the context of contemporary technologies is central. The conjoining of instructional and technological issues will be presented as the key to the development of effective technology-based materials. We will suggest that these considerations can lead to the framing of design guidance to inform the development of technology-based materials that enable active learning. Examples of such guidance will be given.

We will go on to suggest that the form that this guidance takes is crucial to the acceptance and spread of technology-based learning materials. Socio-political issues may, understandably, make some academics resistant to the move to technology-based learning. Whilst it may be impossible to persuade all academics to participate, supportive guidance is likely to prove helpful. We will suggest that the guidance will have to be flexible and accessible if it is to be useful. Principles will be proposed as an effective form of guidance, and examples from the wider field of Human-Computer Interaction (HCI) will be given in support. The paper will conclude by proposing and briefly discussing sample principles for the development of technology-based learning materials.

A strategic multidisciplinary team approach to HE learning environments - what a designer can mean for quality.

I. Smith and J. Smith (Accounting and Finance Division, Staffordshire University)

Staffordshire University is exploring the possibility of adopting a strategic multidisciplinary approach to provision of its HE learning environments.In the pursuit of a quality learning experience for all our current and anticipated students there is an expectation that considerable benefits are to be derived from employing multidisciplinary teams.

The purpose of this presentation is twofold. In the first instance it attempts to introduce some of the corporate strategic policies being explored by the University for maintaining and enhancing its HE learning environments. In particular it will outline a number of permanent teams identified as being key players in the provision of quality learning. The resulting model clearly demonstrates the context within which content providers will work and the nature of their working relationship with the permanent multidisciplinary teams.

The second objective of this paper is to focus on courseware development which is one of a number of innovative teaching and learning initiatives being supported. In particular it will examine the extent to which Electronic Media Design (EMD) can enhance the quality of learning. This fledgling profession brings to the world of courseware production skills associated with product design, animation, publishing and graphic design. The EM Designer can offer creative and visually stimulating solutions and a professional finish to educational material. The paper will attempt to present evidence which links the endeavours of a professional designer with enhanced quality.

The Accounting and Finance Division at Staffordshire University is seeking to explore the mechanisms by which the creative output from designers employed in courseware development can be evaluated. It is considered appropriate that the output from our designer's creative endeavours secures the endorsement of the design community as well as undergoing an evaluative exercise within the Accounting and Finance HE sector. The presentation will document the evaluation questions which have arisen.

A realistic strategy for institutional commitment to courseware development in universities

I. Benest and A. Hague (Department of Computer Science, University of York)
J. Fritz (Faculty of Computer Science, University of New Brunswick)

While it might be laudable for institutions to promote the implementation of computer-based teaching and learning courseware, current authoring systems do not promote its efficient production. The hundreds (and some have reported thousands) of hours required to produce one hour of student material is unacceptable at an institution where the promotion of research is the prime motivator.

Received wisdom is to ensure that students interact with the courseware rather than sit passively as they do in lectures. "Point-and-click" is regarded as one of the recipes that automatically ensures an active learning environment, but it often causes unnecessary interference during learning with no positive gain. Exploratory learning using extensive repositories of factual material, largely through point-and-click on hypermedia links, has been promoted as an innovative learning paradigm. Current authoring systems support this paradigm. But exploratory learning lacks focus and, while it may benefit the student's education, it does not bring rewards in examinations. Much of the currently promoted hypermedia-based courseware emphasises an exploratory presentation style that precludes clear-cut learning objectives. Another major flaw in current authoring systems is the need for the lecturer to be an expert at user-interface design. Adopting a multimedia interface or relying on windows, menus and a mouse to produce a "user-friendly" system do not guarantee the production of a good user-interface. It is now recognised that courseware has to be developed in teams consisting of a lecturer, a programmer, and a graphics designer so that a professional user-interface can be obtained. Of course when the team breaks up, corrections and enhancements will suffer the same delays that plague industrial IT departments.

The traditionally efficient route to learning provision - lectures, laboratories, and problem classes - is being replaced by an inefficient alternative, and this paper will expand on this critical assessment. It will offer an alternative view based upon those metaphors already familiar to the lecturer. With the aid of technology these metaphors will enhance the lecture and problem class approach and not require the lecturer to have user-interface design expertise. This environment will promote active learning within a traditional pedagogical paradigm.

Multimedia Courseware. Never mind the quality, how much will it cost to develop?

I. M. Marshall, W. B. Samson & P.I. Dugard (Department of Mathematical & Computer Sciences, University of Abertay, Dundee)

John Baker humorously describes the failure of individuals, companies, organisations and governments over the last 25 years to deliver the volume of courseware which would spark the active learning revolution. Hardware now exists to deliver multimedia, but the cost of developing quality courseware remains high. What chance does active learning have of widespread adoption if, as Senbetta demonstrated, expert developers produce estimates which vary by up to 500% for developing courseware from the same specification?

This paper evaluates four alternative methods for estimating multimedia development effort and cost against project data before presenting a case for the development of more rigorous multimedia courseware metrics.

Evaluation of Existing Courseware Estimating Methods

Multimedia courseware costing techniques such as the Airforce Interactive Courseware Method , CBT Analysis , CEAC and MEEM are evaluated against the data from 14 multimedia courseware developments. The range of values produced by each method is compared with real courseware data. The methods are evaluated against Boehm and Wolverton's criteria for evaluating cost estimation methods.

Development of Courseware Effort Estimation Metrics

Weaknesses in the existing courseware estimation methods, such as definition of project scope, cost driver definition, and quality are critically reviewed, and the new formal definitions are presented to support the development of multimedia courseware effort estimation metrics which will meet Boehm and Wolverton's criteria.

Papers

The demonstrator model of learning design and the effective use of multimedia

T. King (Department of Information Science, University of Portsmouth)

The EC funded DELTA Project 'Integrating Learning Design in Interactive Compact Disc' (ILDIC) started in 1992. Its aims were to develop a model of learning design from theory and practice and then to produce a generic specification for design in interactive multimedia. This has resulted in the specification for the ILDIC Demonstrator Model of learning design. The model has 10 elements, each of which is a perspective on the relationship between the learner and the machine, viz. learning theory mix, instructional position, machine character mix, environment, use, control, intervention, aesthetics, content and technology. Although ILDIC was especially concerned with multimedia product development, the perspectives offer little advice to designers on the specific use of media, or where integration of media might be effective. Where such advice occurs, it tends to be either anecdotal, such as using professional voice-overs for audio rather than non-professionals, or indirect, such as in consideration of motivational factors in learning styles.

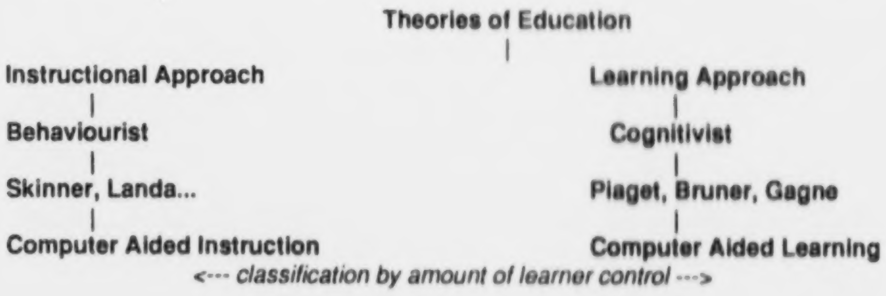
While the accepted main thrust of the Demonstrator Model is to ensure that educational interventions are designed which encourage active engagement with educational material, the effective use of multimedia in this context is not elaborated. The purpose of this paper is to examine each of the perspectives and, drawing on current research in fields such as cognitive science, and media and communication studies, to consider how multimedia can be used within each element to facilitate deep learning. This will include issues such as the learning potential of different media, the use of multimedia to facilitate the abstraction of knowledge from mediated experience, and the importance of multimedia in cognitive strategies. These considerations will be summarised in a set of guidelines for the use of multimedia in learning design.

Learning style and learning strategies in a multimedia environment

P. Paterson and J. Rosbottom (Department of Information Services, University of Portsmouth)

There is a growing realisation that it may be expeditious to combine elements from different theories of learning when trying to derive a coherent and usable policy towards computer mediated learning. The subtle distinction between Computer Aided Learning (CAL) and Computer Aided Instruction (CAI) is lost when the terms are used synonymously. Learning implies an active role for the student. Instruction suggests that the student is more passive; the teacher is in control.

This distinction can form the basis of a possible classification of computer mediated learning, and hence of multimedia tools.



This classification enables the development of a continuum upon which to place various strategies for computer mediated learning, and hence a means of broadly classifying multimedia learning tools.

CAI	*<--- classification by amount of learner control --->*	**CAL**
drill and practice	case studies	all open styles of learning
equipment simulations	experiment simulations	rule-based problem solving
some problem solving	business and strategy games	exploration of info. bases
routine testing		creative composition
e.g. Authorware, Hypercard...	**Supercard, ToolBook, ...**	**Microcosm, Guide...**

Report of Progress of Current Research
Learning style is predisposition to behave in a particular way when engaged in the learning process. Learning strategies are the methods employed by the learner to achieve learning.
Taking the work of Pask (serialist/holist), Kolb (learning Style Inventory) and Witkin (field dependence/field independence) as starting points, research is being done to investigate links between learning style and strategy and multimedia. Such knowledge could prove invaluable when attempting to design multimedia learning materials for the widest possible educational use.

Meeting and discovering language learning needs: using metatext in the translation class - a case study

J. Gillespie (Senior Lecturer in French, University of Ulster at Coleraine)

By means of questionnaires, work produced and other observation it was clear that, although the introduction of the program brought clear benefits to the students' performances and enhanced their language learning skills, they were not always aware of this and in addition on occasion found it difficult to integrate this work into the other demands placed upon them in language learning. Using this data I want to propose that:, as far as the learning of languages through CALL tools is concerned:
1. the students' perceptions of their language learning needs should be established, individually, at the start, with the tutor (for many, learning vocabulary, grammar and idiom had a low priority).
2. that students be given instruction in the learning strategies they need to adopt (in this case for grammar, lexis and translation skills) of which the use of CALL programs would be one.
3. CALL programs should be carefully integrated into an overall language learning strategy for that cohort with all language teaching staff.
4. the use of the computer should be targeted at specific language skills, particularly those which would help to develop language awareness.
5. CALL programs should be used to develop previously neglected language skills
6. the integration between the use of computer programs in class and for independent use by students in the laboratory be carefully managed throughout the academic year
7 that the use of such programs is valuable in diagnosing the weaknesses of students' knowledge and in their learning skills. This can have a positive effect on the development of all teaching/learning strategies including the non-technological.
8. attention to the fun factor and to the market value of CALL coursework should be guiding principles in the use of CALL programs

These specific points about the language learning process will be linked, briefly, to certain general conclusions about the use of CALL programs such as the general level of computer literacy; the culture of computer use for all modules; the need for training in independent learning skills; the adequate provision of workstations; the development of teaching skills to exploit such packages, and the encouragement of support among non-computer literate colleagues.

It doesn't interrupt me when I'm thinking, and you do! - a case study of language learning strategies and text reconstruction software

S. Hewer (The TELL consortium, University of Hull)

The paper will report on a case study involving the use of text reconstruction (TR) software in foreign language learning by secondary language learners across the ability range, with particular reference to their application of language learning strategies normally regarded as characteristic only of 'good' language learners.

Research carried out in the seventies and eighties into the characteristics of 'good' language learners suggested that unlike their less successful colleagues, they make use of a wide range of cognitive and metacognitive strategies. The employment of these strategies appears to promote the processing of input which in turn improves output performance. Informal observation of secondary learners of foreign languages using TR software suggested that the strategies referred to above were activated unconsciously by them in response to the TR task, to the benefit of their language learning. This informal observation prompted the case study.

As an introduction to the case study, there will be a brief demonstration of TR software and an analysis of its characteristics. Within an information-processing model of language learning, those characteristics will then be related to the needs of the learner. The report of the case study will describe the methodology involved in setting up the classroom activity, the taxonomy of strategies used as the basis for data collection and analysis, the data collection techniques employed, the form of data analysis undertaken and the findings.

Particular emphasis will be placed on the 'think-aloud' data collection technique used in an effort to capture evidence of the thought processes undertaken by the students and the method used to time and record their text entries. The findings will be presented with reference to the apparent and actual range and intensity of strategy use undertaken by the groups of participating students and the potential value of software-supported strategy training.

In conclusion, there will be a brief reference to the need to exercise caution in the development of multi-media language learning packages which, whilst providing valuable text, audio and video input, do not necessarily stimulate the learner to engage actively with that input and to process it at a sufficient depth to enable long-term learning to take place.

ISDN - the distance-learning solution

G. Jacobs (European Business Management School, University of Wales)

ISDN (Integrated Services Digital Network) offers the possibility of comparatively high-speed data communication (text, images, sound) across telephone lines without the need for either modems or the installation of special lines to premises. It is reliable, and presents no special problems for the user. It thus seems to offer considerable potential for remote conferencing and distance-learning. Why, then, is it not more widely used, especially in higher education, even though its general availability in the UK dates back several years? This paper outlines the basics of ISDN, from which its limitations become clear, but also proposes that, if properly promoted, it could form the backbone of an educational communication system open to all, not just those academics with access to more sophisticated networks such as SuperJanet.

Learning assistance on wider access courses

J. Lomax (Department of Mechanical and Manufacturing Engineering, University of Brighton)

Courses which seek to accommodate an increasing proportion of students from non-traditional backgrounds, or from "wider access routes", need to adapt to support the wider educational needs of these students.

For engineering where wider access policies are in practice it is stated that the objectives are to increase understanding (of the discipline) and to increase transferable personal skills. It is claimed that these attributes are best accomplished by continuous assessment and that this method is well matched to the backgrounds of students from non-traditional routes where relative strength in one area can compensate for temporary weakness in another.

The requirement of providing increased assessment coupled with a heavy and increasing work load on lecturers does present extra problems.

Two techniques are described to help meet these problems. The first uses a simple application of video. The second uses a method of setting individualised parameters for student assignments that permits peer-to-peer learning and computer-assisted-marking.

Mole: Computer Mediated Collaborative Learning

D. Whittington (Department of Computer Science, University of Strathclyde, Glasgow)

Mole is a novel combination of exploratory learning with hypertext based material and collaborative learning through the use of annotations.

Mole is a client/server hypertext system that supports collaborative in-line annotation.
It falls into the "Different Time, Different Place" groupware category (a type of hypertext bulletin board).

Mole has been designed around existing standards where possible. Hypertext documents are marked up in Hypertext Mark-up Language (HTML). Hypertext Transfer Protocol (HTTP) has been used as the basis for the client/server communications. The client was developed using X and the NCSA's HTML Widget. Both client and server are running on a network of Sun SPARCstations.

Mole was designed to meet a number of aims.

- It should enable learners to take an active role by facilitating in-line annotation of the notes. Both private and public annotations can be made and public annotations may be posted anonymously if wished. Annotations may also be annotated producing threads of discussion.
- It should allow distant collaboration as well as local.
- It should be easy to use.
- It should be easy to put material into the system.

Mole has been used to deliver class notes and practical exercises to two of the departments Scheme classes. A first year undergraduate class of 200 have used the system for a full academic year and a second year undergraduate class of 80 have used the system for one semester. An initial evaluation has been carried out. Feedback from students via a questionnaire was very positive and constructive. Analysis of the server's log file shows that most students made considerable use of Mole as a browser, far fewer made use of the annotation facility.

This paper will briefly describe the design and construction of the Mole system and the results of its first year's usage.

VIRGIL reality

A. Cook, N. Oxley and R. Baird (The VIRGIL Centre, University of Belfast)

The Virgil Centre has been established with TLTP funding in the University of Ulster. The Institutional development programme address itself to the three inseparable issues of materials Content, Design and Strategic Delivery.

Content - In recognising that ownership of subject matter and expertise rests with an individual academic and/or subject group source, the Virgil programme aims to equip those academics with the necessary skills to translate their knowledge into more contemporary and engaging technological formats.

In the short term we have embarked upon a system of information dissemination and staff training. In the short term we are encouraging a parity of esteem between teaching and research outputs of academic staff by promoting the publication of teaching materials.

To date, natural cross discipline groups have formed around simple techniques such as the production of multiple choice questions and electronic books. These developments signify a growing CAL community within the University which is beginning to demand change in the provision of teaching resources and student access to work stations.

Design - Within the average undergraduate programme, we accept that the content design and application of information has not kept pace with rapidly changing visual communication concepts. In recognition of growing expectancy by increasingly visually literate learners, the Virgil Centre therefore aims to introduce academics to the application of the appropriate skills and motivational design techniques required to ensure effectiveness within the learning process.

Strategic Delivery - Effective delivery of technology based learning requires a knowledge of the learner and the learning environment. The Virgil programme has therefore instituted a number of initiatives which have delivered specific details on, for example, student IT access to resources in their own departments and within Central Services provision.

The use of computers as substitute tutors for marketing students.

M. Catterall and P. Ibbotson (Department of Marketing and Business Organisation, University of Ulster)

The use of computers as substitute tutors is associated primarily, though not exclusively, with multiple choice question formats. We report the findings of a project that involved the design, testing and evaluation of a set of computer based tutorials employing multiple choice questions with over 600 students on postgraduate and undergraduate introductory Marketing modules.

The computer based tutorials were designed to meet two main objectives, namely, to help students in their formative assessment and to help staff monitor any difficulties students were experiencing with module content. However, students incorporated the tutorials into their learning in ways that had not been anticipated specifically, they used the tutorials for a number of related but different purposes and their usage patterns varied considerably.

The tutorials were designed so that staff and students would not need training to use them. In this respect the tutorials met both staff and student needs. However, the information on students' performance provided for staff had to be reviewed.

We report on the changes that have been made to the tutorials to take account of user needs and preferences.

Intelligent tutoring systems: real-world applications

M. Elsom-Cook (Electric Brain Company Ltd, 13 Queen Square, Leeds)

Researchers have been studying the use of Artificial Intelligence in Education since the late 1960's. This technology is claimed to produce much more effective teaching interactions than other approaches to computer-based training. The systems are adaptive to each learner, creating an individualised learning experience, and generative, which enables them to create the materials, problems and explanations seen by the learner dynamically.

While there has been considerable research in this field, it has not been until recently that the first commercial Intelligent Tutoring Systems have appeared, and consequently this technology has not previously been used in the real world.

This paper presents experience with three commercial ITSs on two levels. It firstly explains the technological issues raised by producing a commercial system, and the implications it has for the way that users create and modify 'courses' compared to traditional approaches. This covers issues of integrating the systems into context, the provision of special 'authoring' and 'monitoring' tools, and the design of teaching strategies for the systems. The second level of the talk is based upon the feedback and experience gained by having large quantities of system users distributed across Europe outside a laboratory context. These users provide, in a practical sense, the strongest testing that has yet been faced by ITS technology. The talk uses experience gained with 3 Electric Brain products which have been in sites for up to 4 years and have been used regularly for commercial training and undergraduate teaching.

The general conclusion of the talk is that there are a large number of educational applications for which existing ITS technology can provide an appropriate solution. In these areas the ITSs are as effective, or better than, good quality CAL. More significantly, subject matter experts can create and modify the 'courses' easily, without programming knowledge, and with a speed which is at least an order of magnitude faster than using a conventional CBT tool.

Development and implementation of a multimedia teaching package in comparative literature

B. Heins, C. Larrea and C. Burnley (Faculty of Humanities, University of Luton)

The development of a multimedia teaching package for the tertiary level study of Comparative Literature has been conceived in response to students' struggling with basic concepts and terminology during an intensive first year survey course. The production of the software package The Origins of the European Novel aims at complementing lectures and seminars as a self-study tool. Important terms such as myth, epic, romance, folklore and picaresque will be explained and backed up with examples from relevant texts, historical and cultural background, and additional bibliography and criticism. This will give the students a sound foundation in their introductory module to the field, needed for the three core courses that will follow where the terminology will resurface.

The paper will highlight the problem of devising a package that is both academically sound, educationally effective and visually attractive. We will raise the question of how the programme can involve the users actively and guide them to activities beyond the screen. Particular attention will be paid to the difficulty of using computers in teaching literature: the need to edit the material in order to ensure an engaging and clear learning structure for the user, avoiding an overwhelming use of text on the screen.

The use of text is limited by the inclusion of visual material, such as photographic images or videoclips. In a subject which is essentially text-based such restrictive use of text could become easily counterproductive to the educational objective and the academic quality of the package. Solutions adopted during the ongoing development of the package, such as supplying guidelines/bibliographies for further research, will be presented and discussed.

Meeting academic objectives for distance learning with CD ROM

G. Einon, M. Jones, N. Heap and M. Karlsson (Departments of Biology, Academic Computing and Electronic Systems, Open University)

Our presentation describes the strategy developed for the Open University Course THD 204 (IT and Society) for the use and integration of materials accessed from CD ROM within 'conventional' OU course materials. These provide students with a personal library of articles, clippings and audio and video resources used to allow a departure from the conventional OU study pattern in which students follow prescribed study paths using specially written course texts.

THD 204 is being produced using conventional OU course team working practice. To accommodate the multimedia strand within the production process, the issues and practice resolved in the development of the production of CD ROM-delivered material are:

- the choice of the CD ROM authoring / retrieval system
- the nature of the materials supplied on CD ROM

- .a keyword categorisation system to allow CD ROM material to be accessed by students in a way that allows them to locate material relevant to specific course themes and issues
- .a system of mark-up conventions to allow a relatively large and diverse academic authoring team to mark-up paper documents to a) relate document contents to standard course-wide and local keywords to give student access through indexed key word searches and to b) specify hypertext access structures.
- .a conversion regime that allows secretarial support staff to work from author generated marked up paper documents to annotate electronic copy suitable for pre-processing
- .a pre-processor to convert marked-up 'electronic' text to a form suitable for processing by the Microsoft MultiMedia 2 electronic publication compiler
- .the development of a standard structure for electronic documents to allow readers to evaluate documents on CD ROM prior to reading

Institutional support for change in teaching and learning

M. Oates (Cheltenham and Gloucester College of Further Education)

This paper will consider:

1) The formation of a new unit - the Flexible Learning Development Unit to support College wide initiatives developing learning materials - courseware etc including design and development and production.

2) Convergence within the Faculty of Information Services to accommodate new delivery strategies - the establishment of a new Flexible Learning Area within the Learning Centre for appropriate delivery of new learning materials.

3) Professional Development Unit - staff development programme to support staff through the process of change - adjusting to new teaching and learning strategies.

4) Work in progress - to include projects funded by EHE to develop learning materials.

5) College wide IT training programme.

Towards the institutionalisation of learning technologies in higher education: staff development issues

J. Rothwell (Staff Development Centre, University of Manchester)

Universities are undergoing a time of rapid change. A substantial increase in undergraduate numbers together with the introduction of semesters and modular degrees have initiated the need to redesign courses, while national initiatives such as the Teaching and Learning through Technology Programme (TLTP) and Enterprise in Higher Education (EHE) have forced a review of methods. Other issues such as the Quality Audit of Teaching and the pressure to maintain (or increase) research ratings are contributing to the changing culture.

The greater use of technology is seen by many to provide a way forward to staff development needs in this changing environment. The challenge is to demonstrate the validity of this and assist staff to adapt. Training though important, is not the total solution. The traditions of academic freedom are deeply engrained in university culture and this fundamentally affects the scope for innovation and associated staff development issues.

This paper discusses the strategy for staff development in *New Technologies in Teaching* that is being implemented at Manchester. The different types of activity are described and evaluated against the background of the prevailing cultural changes. Conclusions, based upon our experience, are drawn which point the way towards the successful institutionalisation of learning technologies in Higher Education.

Discussion and Hands-on Workshops

WORKSHOP 7. - LEARNING WITH CAL COURSEWARE

Experience of using Course Builder (an authoring program for the Macintosh) to design interactive revision guides for clinical biochemistry lectures to medical students.

B. Cowan (University Department of Pathological Biochemistry, Royal Infirmary, Glasgow)

Formal lectures are likely to remain a key component of medical undergraduate teaching at the University of Glasgow. Presented here is a concept (the 'lecture revision guide') which represents a simple way which interactive computer based learning can be used to increase the effectiveness of traditional teaching.

A lecture revision guide is a short interactive programme to be used by a student after receiving a formal lecture, or when revising for an examination. Lecture revision guides can be accessed from cluster based PCs, borrowed on floppy disk, or downloaded from a University server. Each guide contains:
a) A statement of the objectives of the lecture.
b) An interactive quiz, based on lecture content, requiring input from the student in a variety of ways. The questions allow the student to assess if the lecture objectives have been met.
c) A lecture summary.
d) Quality audit. Each student is asked to assess the lecturer's performance under a number of headings. This input can be used for personal feedback by the lecturer, and perhaps for course audit. Such reports can be stored on the delivery machine and downloaded, or stored and accessed from a network server.

Course Builder authoring software for the Macintosh contains all the multimedia capabilities: graphics, sound, animation, text and video, and uses a 'course map' analogy to create self paced learning sequences. Course Builder's strengths for educational projects is in the variety of its INPUT states and in the construction of conditional paths which allow branching based on the user's abilities. Standalone applications are created easily and distributed without royalty payment. Student feedback in questionnaires on the use of these lecture revision guides has been both positive and encouraging. A more formal assessment is underway.

Medical students as multimedia authors

S. Whiten, H. Allen and J. Aiton (School of Biological and Medical Sciences and the *Computing Laboratory, University of St Andrews)*

Our objective was to implement an innovative approach to the study of histo-pathology, anatomy and physiology which would directly involve our 4th year intercalating medical students as creative participants in the learning process. They attended a series of workshops where they acquired skills which would enable them to create multimedia tutorials on clinically relevant topics aimed at 3rd year medical students. This approach promoted the acquisition of a deep understanding of a subject area, development of observational skills and had the additional benefit of stimulating students to consider the issues and strategies involved in teaching their peers. Thus, the project achieved three main educational outcomes; students acquired:

factual knowledge as they assembled information
a broad range of transferable educational skills as they integrated and synthesised the material into tutorials
a wide range of transferable technological skills.

Since the projects were a component of the final honours degree mark (17% of the total), we expected students to devote approximately 1 day per week for two terms. 9 computer workshops were given by a specialist computer adviser in which they learned how to create HyperCard stacks (on the Macintosh) and to capture and integrate both still and moving digital images with text. The remaining time was spent constructing the interactive tutorials. Typical projects included tuberculosis, arthritis, breast cancer, malignant melanoma and endoscopy. In addition to the computer adviser, the students also had help from academic supervisors. Students clearly enjoyed the creative freedom and the opportunity to consolidate a new set of transferable skills, especially those in computing technology, communication and time and resource management

Undergraduate mechanical engineering students' experience of computer-based workshops

A. Brown (Department of Educational Studies, University of Surrey)

A team from the Department of Educational Studies at the University of Surrey has been evaluating a project on 'Quality in Engineering [Education] through Simulation Technology' (QUEST).

For 1993-94 the evaluation focused upon the teaching and learning processes in the computer-based delivery of a first year undergraduate solids course in mechanical engineering. The evaluation team used a mixture of observation, surveys and interviews to build up a picture of the teaching and learning processes.

Findings

1. There was a tremendous richness in the variety of learning activities taking place in the workshops and in the quality of tutor-student and student-student interactions.
2. The computer-based workshop delivery was seen by the students as requiring much more involvement and being much more interesting, effective and efficient than lecture-based delivery, **yet** the computer-based activities undertaken in the workshop were seen as markedly less useful than a range of other more traditional tutor and student activities.
3. There was also considerable evidence of student-student support both within and between pairs.
4. The success of many pairs though could mask possible problems:
   a) passive partners understanding less than they think they do, b) for weaker students, much depends on the quality of support they get from other students, so should more effort be put into developing students' 'peer tutoring' skills, c) should 'lone' students be encouraged to participate more fully in pair or group activities?
5. Students saw the 24 hour a day access and the dynamic visual representations as being the greatest benefits of using the computer-based approach.
6. Students also highlighted how the biggest weaknesses of the current program could be overcome: need for access to 'fast' solutions to computer problems and the need for worked examples in the simulations, so that students could see the stages adopted in an effective approach to solving solids problems.

WORKSHOP 8 - ACCESSING THE GLOBAL DATABASE

ELF: The Electronic Learning Facilitator

R. Kirby, P. McAndrew, A. Kilgour, H. Taylor and T. Mayes (Institute for Computer Based Learning, Heriot-Watt University)

As the world-wide computer network becomes ubiquitous, new tools are being developed, such as the World Wide Web (WWW), for the delivery of multimedia hypertext based documents. Similarly, there is an explosion in the amount of email, bulletin boards, and Usenet News available. This is leading to the major problem of information overload.

To address this problem, the New Technology Initiative (NTI) of the Joint Information Systems Committee (JISC) is funding the ELF project. The ELF project started in December of 1993, with the goal of producing a tool for installation in UK academic sites.

This paper will first discuss the new networked information sources that are appearing around the globe, and then analyse the requirements of learners for accessing this information. From the requirements, the paper will show the desirable features of an ELF, such as monitoring the user at work to gain hints as to what the user is doing, being guided by the user directly, and utilising information gathered from other ELFs, or from monitoring the various information sources for announcements of new services, updates of information, etc.

The main body of the paper will illustrate the current progress on the project, outlining the implementation of the ELF. ELF is written using various high-level languages such as the Tool Command Language (TCL) and Perl, as well as the more traditional C++. It consists of various agents, each agent having a specific task to perform, such as monitoring a WWW site for any new documents, or monitoring a Usenet Newsgroup for articles that might be of particular interest to the owner of the agent. Finally the paper reports on results from users of the prototype.

Using WWW to deliver IT training in a heterogeneous environment

C. McMillan and M. Kalugin (Computer Centre, Lancaster University)

The Project: 'On-Line Training Materials for INGRES' is a three year ITTI (Information Technology Training Initiative) funded project which started in January 1992, and is due to complete in December of this year.

Major Objectives: To develop a set of training materials for the INGRES relational database management system to enable staff and students to teach themselves INGRES, and to develop an Information Server which would host a variety of different training materials suitable for on-line use, including the INGRES Training Series.

Development of the On-Line Information Server: The original INGRES Training Material Server was designed and developed to specifically host on-line training materials for INGRES. In addition to the INGRES Training Series, it was always envisaged that other supporting materials would be hosted on the server. This includes a 'Frequently Asked Questions' section, INGRES News, a self-help conferencing system, and quick tutorials on specific aspects of INGRES.To facilitate this, the INGRES Training Materials Server provides a menu driven hierarchical engine which allows users to browse through menus and view the INGRES Training Series and other associated training material. We have now adopted WWW standards to ensure universal accessibility of the INGRES Training Materials Server.The INGRES Training Materials Server is based at Lancaster University, and is accessible via Telnet, Gopher, WWW and anonymous ftp.

The INGRES Training Series: The INGRES Training Series is a modular task-oriented set of self-teach materials. The Training Series is divided into five main teaching units plus an additional reference unit. The planned units are:Unit 1:Getting Started. Unit 2: Using INGRESforms. Unit 3:Introducing SQL. Unit 4:Database Reporting. Unit 5:Developing Database Applications. Unit 6:Reference Material (This includes a copy of the 'Car Hire' database, which is used throughout the Training Series for Practical Example and Illustration).

Information available on the Prototype system: The INGRES Training Series is not yet complete, so, only a restricted set of units and modules are available on the system. This will at least give a 'taste' of things to come. A Frequently Asked Questions (FAQ) section has been compiled about INGRES and this is available on the system along with various other 'bits and pieces' of information regarding INGRES.

Interactive teaching of surgery between remote centres.

D. Jameson (Audio Visual Centre, University College London)

This three year project is coming to the end of its first year, and it is planned to start teaching in October 1994. The first year has been spent in planning of the teaching programme and testing the SuperJANET ATM video network. Our submission will discuss the experience of the two areas.

Teaching Issues:
The issues raised and how they have been resolved in bring 6 universities together to give a single collaborative course. The issues are different to those in most CAL projects as we are concerned with a live interactive environment with live teaching, and live discussion. We feel there is a distinction between live teaching which is a group activity and individual learning. We are preparing learning material to be provide through the WWW and which utilises a central image resource available on the network.

Technical Testing Issues:
We believe there is a distinction to be made between conferencing and teaching on a live video network and this has important requirements on the performance of the network. There are technical issues concerning the organisation of session, the control of switching between sites, the control of audio quality (echo chancellors) and the maintenance of video quality. It is now clear that there has to be strong partnership between the computer expert in ATM technology and the AudioVisual expert in handling the audio and visual signals to maintain the highest quality before the signals are compressed and transmitted over the network.

This project is also making use of a central image server on the video network which is a resource of visual information in the surgical domain. This includes both still and moving images, and although we are currently using an analogue server we have plans to use a digital server in the near future. The presence of a networked image server provides some very distinct advantages for collaborative teaching and learning. The use of JPEG, moving JPEG and MPEG will all be important in the digital server.

WORKSHOP 9 - MANAGING THE COURSEWARE DEVELOPMENT LIFE CYCLE

What went right and what went wrong: three CAL projects in retrospect.

D. Pollard (School of Dentistry, The University of Birmingham)

This paper discusses three quite different CAL projects involving a CAL specialist working in a dental teaching hospital. Each project produced a piece of Windows-based software for both internal and external use and required collaboration with clinical lecturers and technicians acting as subject specialists. This paper does not focus on the successfully finished products but on the production methods employed and the sometimes rocky path to their completion.

For each project the following issues will be discussed:

- aims and planning;
- the development life-cycle;
- the CAL specialist-subject specialist interface;
- choice of educational format;
- editing of subject matter;
- programming problems;
- time scales;
- evaluation.

The case studies outlined in this paper portray a fairly typical range of experiences and highlight issues which are at the crux of CAL development in UK higher education.

Developing CAL courseware: practice versus theory.

J. Booth, J. Foster and D. Wilkie (Department of Psychology and Speech Pathology, Manchester Metropolitan University)

The formal systems model for designing CAL is based on the concepts which underpinned programmed learning. But it has disadvantages: the underlying principles are derived from studies conducted in non-naturalistic settings using obsolete technology. The model views the learning process as a series of discrete events which can be isolated without regard for their interactions, and applies a recipe-book approach to implementing learning.

The development of a computer-delivered introductory course on memory for psychology students at MMU initially followed the formal systems model, but when trying to put it into practice further disadvantages were revealed. Its complexity can lead to 'analysis paralysis' when the developer attempts to go through the 11 steps of instructional design and incorporate the 9 principles of educational psychology, while weighing the 11 implications of educational psychology for CAL design and the 12 characteristics of effective CAL.

Consequently, the formal systems approach was abandoned in favour of an informal model which assumes that teachers know how to teach, what approach to take, and what material they want taught. It focused on realising those requirements with the available hardware and authoring package.

Programmed learning's failure has been ascribed to it satisfying neither students nor teachers. Consequently, emphasis was placed on satisfying both groups of users. Student appraisal of the developing package was sought and used as a basis for modification.

The prototype courseware of 12 modules, requiring three to four hours of study time, is being used and evaluated by students and staff. Informal feedback from students suggests that they like it and want more. When formal evaluation is complete, the package will be revised for use in the forthcoming academic year.

WORKSHOP 10 - LOW COST APPROACHES TO COURSEWARE DEVELOPMENT

A spreadsheet system for data analysis and mathematical modelling

R. Beare (Department of Science Education, University of Warwick)
J. Hewitson (Biology Department, Oundle School, Peterborough)

A number of examples will be demonstrated illustrating how spreadsheets can be used for data analysis and mathematical modelling. The examples will all use the Warwick Spreadsheet System which is based on Microsoft Excel and which is designed to make maximum educational use of the powerful features of Excel in the simplest way possible. Each example will be chosen to illustrate a particular aspect of either data analysis or modelling. Examples will be drawn from a range of subject disciplines. They will also be chosen to illustrate how the Warwick Spreadsheet System can make both the writing of new spreadsheets and their utilisation easy and quick with otherwise quite sophisticated operations being carried out in a very straightforward way.

The pedagogic benefits of spreadsheets will be emphasised through discussion of the particular examples and how they can be used to encourage open-ended and investigative approaches to learning. In addition evidence will be briefly presented showing the superiority of a predict with reason - observe - explain sequence over purely open-ended or prescriptive approaches in a particular classroom context.

Quick and 'not-so-dirty' hypertext with Windows Help files.

C. Jex (Management Science Department, Lancaster University)

Almost everyone who has used a Windows program will have used a help file. Help files are the most widely used hypertext applications by a large margin and define a universal standard for hypertext applications under Windows. Publishing simple CBL applications as help files means they can be run on any Windows PC without further cost - either monetary or in terms of 'learning overhead'.

The Windows Help compiler is powerful software, which manages much of the complexity of building a help file from a word processed document. For example it automatically manages hypertext jumps between topics, browse sequences, searches over keywords and glossaries. Help files can include a variety of macros and hotspot graphics, which for example can be used to run other programs including multimedia.

However, although comprehensively documented by Microsoft, the help compiler does not offer an easy route to writing help files. It is far from intuitive, it is essentially a DOS based program, and requires the author to envisage the multi-dimensional nature of the final product before it is compiled from a one dimensional document.

A whole new generation of help compiler interfaces are available which enable an author to quickly convert a set of word processed lecture notes into a real hypertext document which can be viewed and operated by any one with a Windows based PC.

The author will explain the main features of a help file and will convert a set of lecture notes into a help file hypertext document in the course of the demonstration.

Student development of computer based tutorials in hypercard and authorware

J. Walker, M. Cuttle and H. Macleod (Department of Pharmacology, University of Edinburgh)

Medical students at Edinburgh University select from a range of options during the sixth term of their medical course.

12 students out of a class of 190 elected to do the option "computers in medical education". Working in pairs, they were either assigned a question, or selected one of their own. The question had to be one that was

frequently asked by students during tutorials in the Pharmacology course. The object of their exercise was to design a short program to answer the question.

Three pairs selected Authorware (one on PC, two on Apple Macs), as their medium, and three selected Hypercard. Sixteen days were available to complete the process, although in practice it was difficult to restrain the students from working all hours. Computer experience of the students covered the range from near - phobic to skilled. Eleven students completed the course and gave a demonstration of their work on the last day.

The output at the end of the option was a set of 6 lively, quality programs, each running for about 20 minutes, that will be used effectively for classes with only minor adjustments. Student opinion was sought on the relative qualities of Hypercard and Authorcard to work with. Students road-tested their programmes on other students from outside the course, and the responses were enthusiastic. The various programs are available for demonstration.

WORKSHOP 11 - DEVELOPING A COURSE TO TAKE ADVANTAGE OF LEARNING TECHNOLOGY

Integrating Advanced Learning Technology into the curriculum: a three year case study

T. Boyle (Manchester Metropolitan University, Manchester)

A major theme for learning technology is how computer based learning environments should be integrated into the curriculum. The options vary from the provision of incidental multimedia material to a transformation of the teaching and learning experience. This paper will report on the experience of the Computing Department at MMU in a radical transformation of first year programming courses based on innovative learning technology. This transformation has taken place in two phases over a three year period. The impetus for the first phase came not from a 'technology' perspective but from an argument that an innovative pedagogy, implemented in a CAL system, could transform the learning of programming. These ideas led to the development of a large system called CLEM. This was implemented in GUIDE, a hypertext authoring system, and delivered in a lab of thirty two 386sx personal computers. CLEM was introduced in September 1991. It was used to replace lectures in programming for 240 students following four different courses routes. CLEM delivers over 50 hours of computer based learning. It is now used in three universities and has delivered over fifty thousand hours of computer assisted learning. The paper will report of the main issues which arise from this extensive use of a radical computer based learning environment.

In September 1993 a second phase in the introduction of learning technology commenced. CLEM supports the learning of a programming language (Modula-2). A complete learning technology approach requires that program design should also be covered. A specially constructed computer based tool for program design was introduced to one of the courses at MMU. The time saved through the use of CLEM permitted a more intensive treatment of program design. The paper will report on the method used for this dual use of learning technology, the student evaluation, and the plans for a final phase 3 of learning technology enhancement to commence in September 1994.

Flexibility in course provision

A. Rae and P. Samuels (Association for Learning Technology, University of Oxford)

Basic discrete maths is now taught to most students of Computer science, in particular it is seen as necessary for understanding methods of formal specification such as Z. Conventional academic approaches often fail with students who do not have A level Maths. The present project, building on 9 years of experience, aims to produce a self contained learning package consisting of text, video, group projects and computer tutorials to enable students to learn at their own pace with a limited amount of tutorial support.

We have now produced a pilot version of our course and this has been tried out on 200 students of very mixed background. Their work has been assessed in a variety of ways including group work in a software supported environment, diagnostic tests and conventional exams. Overall results were good, with an average mark of 55% and about 20 students being referred to do some more work as they clearly had not got onto the later part of the course.

Because of the flexible nature of the tuition, by text, video and computer, with no lectures, we expect most of these students to be able to master the material with some tutorial support, during the present semester.

The students seemed to like the course and we are planning a follow up study of their approach to the course.

We are now hoping that other institutions will try out our material.

Data analysis and information processing in biomedical sciences: a 2nd year module in the degree of Bsc in Biomedical Sciences at the University of Aberdeen.

F. Bowser-Riley, K. Page and M. Radcliffe (Department of Biomedical Sciences, University of Aberdeen).

The objective of this course (12 week, one third full time) is to provide a knowledge base concerning methods of information retrieval, data processing and presentation of scientific material by means of active development of teamwork, communication and information technology skills.

The course consists of lectures, tutorials, group discussions and directed microcomputer working sessions concerned with data analysis and information processing in Biomedical Sciences. Following an initial period on the use of the personal computer, undergraduates are required to analyse sets of experimental data drawn from a range of anatomical and physiological examples. The skills involved in the analysis, presentation and communication of scientific information are developed further by each individual in the context of a researched 3,500 word project essay. The essay topic is selected within an area of Biomedical Science not previously encountered by the undergraduate. Instruction is given in the use of library resources (including IT based bibliographic searching techniques) and in the presentation of scientific papers and oral communications. Progress is reviewed by individuals within designated support groups and by means of regular tutorials. Each undergraduate is required to submit the project essay in electronic format, and to present a summary of it orally using electronic media. A component of the continuous assessment of each undergraduate is derived from a peer assessment of the oral presentation based on agreed criteria.

A summary of the undergraduate course notes and booklets together an outline of the design, implementation and evaluation of this course will be presented as a case study.

WORKSHOP 12 - APPROACHES THAT WORK

Multimedia - the solution to all our problems

J. Darby (Computers in Teaching Initiative Support Service, University of Oxford)

Multimedia challenges our perception of education. It forces us to adopt a new paradigm in which the student is central and teachers take the role of learning enablers. Multimedia puts the student in control; gives her access to vast amounts of knowledge and with this knowledge comes power. The student is *empowered*. Multimedia, through its very nature, will sweep away lectures, conventional assessment and libraries as we know them. Students will no longer be constrained by conventional course structures but will travel the highways of hyperspace charting their own courses.

The textbook will be a thing of the past, discarded as impossibly rigid and static. Students will not only gain knowledge from multimedia sources but will also contribute insights of their own. The distinction between teacher and learner will cease to have any meaning. Both will become partners in the pursuit of knowledge.

Higher education will finally become open to all since multimedia removes the fetters of time and place. The electronic superhighways will reach everywhere enabling learning to take place wherever and whenever a student wishes.

This is the future that multimedia is bringing us - or is it? Why has higher education proved quite so resilient to change? Why are there so many demonstrations of the power of multimedia and so few applications? How can we distinguish the reality from the hype? Come ready for a good argument.

The impact of a Learning and Teaching Fund on teaching quality: some reflections for institutional policy.

D. Edgar (Education Development Service, Glasgow Caledonian University)

The Glasgow Caledonian University has implemented, on a pilot basis, a three year Learning and Teaching Fund project to encourage innovation in teaching methods within the University. This project, which has had annual budget of £70,000, £100,000 and £130,000 for successive years of its life, is now conducting a total of 51 projects and two programme areas (involving a number of linked projects) have been supported with the majority of these projects related to the application of Information Technology to teaching and learning.

This presentation will examine the effects of the Fund upon the University's commitment to encouraging innovation and enhancing teaching quality, with particular reference to how lessons learned might influence future institutional policy in the selection, management and evaluation of projects, and in their effective embedding within the curriculum.

The Scholar Project - developing hypermedia for resource based learning in higher education

S. White and P. Maier (Interactive Learning Centre, University of Southampton)

The Scholar Project is a three year project with the remit to shift the culture of the university by altering the mode and style of teaching and learning in such a way that staff and students use multimedia and hypermedia materials as an integral part of their academic programmes.

The project makes extensive use of Microcosm - an open hypermedia system developed at the university - to provide a flexible, resource-based, cross-platform, multimedia learning environment through which academic staff can readily create, reuse and customise learning materials to suit their own teaching requirements.

This is coupled with an extensive modular staff development programme concentrating on the skills and knowledge associated with the use of computers for teaching and learning. The project is also working to influence change in institutional policy to enable the university to anticipate and respond to the needs of staff and students in the provision of new and rich learning environments and supporting infrastructure

In the context of using open hypermedia systems for teaching and learning we are particularly interested in examining the use of resource based learning within higher education, and the inter-relationship between the conventional approach to resource based learning and the novel use of hypermedia in this area.

This discussion workshop will explain the functionality of Microcosm, examine the experience of applications developed to date drawing largely on work in Oceanography, Human Morphology, Engineering Materials and Spanish. We will discuss the potential and limitations of hypermedia in higher education.

HANDS-ON WORKSHOPS H3 AND H4

Mathwise :computer - based learning of discrete mathematics

D. Mackie and P. Thomson (Department of Mathematics, Napier University, Edinburgh)

In 1992, the United Kingdom Mathematics Courseware Consortium (UKMCC) was awarded funding under the Technology in Teaching Programme (TLTP) for the development of computer-based mathematics courseware for students of science and engineering. Within this consortium, Mathwise, comprising 25 modules designed for independent study, is currently being developed at universities throughout the UK. The modules are designed for foundation and service mathematics.

As members of UKMCC, the authors are producing a level one mathematics applications module for Discrete Mathematics using the PC - based multi-media authoring system Toolbook. The mathematics module being developed at Napier is designed for teaching discrete mathematics to first year students on Computing or Software Engineering courses. Typically, students entering these courses may have very little idea of why they should be studying mathematics at all. A primary aim of the module is, therefore, motivational whilst bridging the gap between school or college and university.

The workshop will provide a hands-on opportunity to use the Discrete mathematics module. The mathematics is introduced through a series of case studies, each of which presents a situation for which a software specification is required. The topics presented include set theory, propositional logic, functions and relations which are then used to construct a mathematical model of the software system. Each section also includes exercises with worked solutions. In the workshop, various development issues will be highlighted and participants will be encouraged to explore the alternative learning approaches adopted. The module is designed for independent learning. The software is windows - based, interactive and highly structured with multi - layered navigation. From all points within the structure there is access to common reference materials and software tools such as a graph plotter and a calculator.

COSACC - the hands-on synchronous groupware simulation for the teaching of cost accounting

C. Gray (Management Centre, University of Bradford)

The author decided that an alternative approach to teaching cost accounting for manufacturing systems was feasible, which would develop the students' understanding of the structural relationships in the problem, and would be based on a computer simulation of the information flows in the generic manufacturing system. This approach, presenting cost accounting as an integrated subject and providing similarities to "Gestalt" learning theories, has resulted in "COSACC", which provides in software an accounting system for planning and control based around a dynamic business simulation operating in real-time which requires the participants to use and understand the concepts of historical accounting records, budgets and standard costing, in order to successfully complete the course.

Here the strategies of both collaboration and competition are employed to grasp the attention of the participants; learning is reinforced by the motivation of working in groups and competing against other teams. Problem solving strategies have not only to be formulated but also implemented. Drawing upon the analogy with Gestalt learning theories, COSACC provides an unsolved problem which creates ambiguity or organisational disbalance in the student's mind, a negative condition which exists until the problem is solved. The reduction of ambiguity is then an intrinsic reinforcer, the tutor helps the students to see the relations and organise their experiences into meaningful patterns.

The economist's factors of production are modelled by competitive material, labour and product markets, plus the imputed cost of finance and factory size. Up to 9 different products can be made from a maximum of 9 materials plus labour; this contributes to the complexity that students fi8nd cognitively challenging. The dynamic model also emphasises the relationship between flows and stocks in the system, delays and lags leading to oscillatory behaviour, circular causality which may cause unstable feedback loops, and non-linearity provoking dramatic changes in system behaviour.

Discussion and Hands-On Workshops

WORKSHOP 13 - APPROACHES TO STUDENT ASSESSMENT

Smart marking: computer-based assessment and learning needs

S Barr and P Duncan (Department of Business Administration, Glasgow Caledonian University)

In recent years the UK Higher Education sector has been confronted with a number of new initiatives including - coping with increased student numbers, achieving higher research profiles, and quality assurance. This paper documents one project undertaken in response to these initiatives.

The primary aim of the project is to develop a computer-based assessment (CBA) facility, which would enable the automation of a significant portion of the summative assessment process in the target course. Project objectives and critical success factors are identified. The development process is described, and student/staff responses to the pilot material are evaluated.

Lessons to be learnt from the pilot study are examined in detail and the next phase of the project is outlined. Highlighted are a number of proposed 'quality guidelines' for the exploitation of CBA (broadly defined) as a tool for question formulation, satisfying learner's needs, formative assessment and revision purposes.

Pilot assessment material in the subject area of Information Technology will be demonstrated. Topics for discussion include the continuing development of 'quality' within the facility, and broadening the scope of material to satisfy the higher levels of Bloom's taxonomy of educational objectives. The articulation of views by delegates will inform, stimulate and challenge their appraisal of CBA's utility within their own institutions.

Confidence assessment in the teaching of basic science.

A. Gardner-Medwin (Department of Physiology, University College London)

We have introduced confidence assessment into automated teaching and self-assessment, with two aims. Firstly, it trains students to develop the habit of assessing whether their knowledge and reasoning is sound. Secondly, it allows us to ask simpler questions in computer exercises (expecting confident answers), without the contortions sometimes introduced into questions to obtain a suitable level of difficulty.

We use a program system developed for this purpose, called LAPTTOP (London Agreed Protocol for Teaching and Testing of Physiology). Confidence assessment is handled by asking the student, after each answer, to choose the mark to be awarded if the answer is correct. The available marks are 1,2,3 and they carry penalties if the answer is in fact wrong of 0,-2,-6 respectively. To maximise scores, students should choose confidence level 2 only when they think the probability of the answer being right is >67%, and 3 only when it is >80%. Questions may be binary (e.g. Chloride ions are negative (T/F)?) or they may require word, number or quantity answers (e.g. What current flows through 10kohm connected across a 9V battery? Answer: 0.9mA, 0.0009 amps, etc.).

Students generally like the confidence assessment, particularly since it offers an option to avoid negative marking. It is a new learning experience, and one that they seem to appreciate. There is a significant benefit when writing self-instructional material in that the author can use simple direct questions to keep the student involved, without either able students feeling the questions are condescending or weak students (with more challenging questions) feeling demoralised. Good students have the challenge of risking high confidence levels, while weak students are encouraged that some answers are turning out right, hopefully with increasing confidence. The LAPTTOP program system is available to University Departments agreeing to pool material with other registered users.

WORKSHOP 14 - SKILLS TRAINING FOR STUDENTS

Study skills to enable active learning

R. McAleese and C. Gunn (Heriot-Watt University, Edinburgh)

Learners will have to acquire a raft of general and specific study skills to enable them to make the most of innovative technology based learning systems. As part of the general undergraduate curriculum at Heriot-Watt, the Centre for Combined Studies is offering three linked modules that prepare students for study and active learning. The first module is concerned with a generalised approach to study and learning - ranging from study skills (e.g. note-taking) and IT based skills (e.g. data visualisation) to auto-monitoring and reflection in/ on action.

This paper reports on the first complete presentation of the module with 20 undergraduate students in the third term of the 1993-1994 academic year.

The module adopts Caroll's Minimalist approach to skills acquisition. Learning skills and developing appropriate study approaches results from tasks and activities. The course centres around a Theme Lecture (in Week 4) and a Project Report (submitted in Week 10). Students have to acquire the relevant skills in weeks 1 to 3 to allow them to get the most out of the lecture (e.g. listening, word processing, note taking). The lecture content is of general interest but with sufficient scientific and academic content to challenge the learners. After the lecture, the students acquire skills such as data visualisation, information retrieval and report writing. These skills enable the students to submit a report using all or most of the IT and study skills acquired. This year the lecture concerns grain malting. Allied to the lecture is a data set, related to malting, that provides the materials for skills such as using spreadsheets, graphing and database management.

This study skills module is using initial versions of the Courseware for Learning Study Skills (CLASS) applications developed during the Teaching and Learning Technology Programme (TLTP -Phase I). In particular the CLASS module on Report Writing forms the basis for students learning about report writing skills.

Data has been collected on the student's approach to learning using a modified Kolb inventory These data are compared with process and product performance measures, general attitudes to study, self-confidence measures and specific skill data (e.g. note-taking).

The case study as a vehicle for integration of information systems and technology with a variety of disciplines

M. May and G. Hill (School of Financial Studies and Law, Sheffield Hallam University)

Information Systems and Information Technology are all too often taught as discrete subject areas, treated either as an option, peripheral to mainstream studies, or the focus is upon technical detail, both often ignoring the integrative nature of the subject. Additionally many Universities recognise the need to develop not only academic learning skills in undergraduates but also the transferable skills and qualities required by employers. This poses problems for the academic in how to actively engage, motivate and challenge the student, achieving a multiplicity of objective without confusion.

The authors of this paper hypothesise that Information Systems and Technology should not be taught in isolation, rather it should be seen as integrative with a variety of other subject areas. Further, they are committed to developing students' personal skills and qualities and to enhancing the student learning experience through appropriate methodologies.

This paper explores the use of case study as an integrative vehicle - integrating discrete topic areas within an Information Systems module, transferable skills and relevant topics from other disciplines. The approach described focuses upon an attempt to depart from the traditional segregation of accountancy and information technology by attempting to integrate the two disciplines by an on-going student centred case study.

The issues addressed include:

- the rationale of the case study as an appropriate delivery strategy.
- the method of implementation.
- the use of technological tools within the specified module.
- the integration of information systems and technology with other disciplines.
- the development issues and problems encountered and how they were overcome.

These issues give rise to specific questions for debate including the transferability of the concepts described to other under graduate courses and its adaptability in meeting the changing demands placed upon information systems by both academia and the workplace.

WORKSHOP 15 - EVALUATION OF CAL COURSEWARE

Courseware evaluation: when, where, what and how?

P. Barker (School of Computing and Mathematics, University of Teesside, UK)

If it is to be effective courseware must be of an appropriate standard. Unfortunately, there is little, if any, commercially available 'quality' courseware to support the teaching of the majority of academic subjects. In order to overcome this problem most academic courseware often has to be produced 'in-house'. Courseware production involves the design, creation and integration of multimedia pedagogic assets into products that can be used in flexible and adaptable ways. Obviously, if they are to be useful, these assets must be capable of fulfilling a range of pre-specified learning and training objectives. The assets that are created can utilise text, sound, pictures, animation and motion video resources in ways that reinforce the underlying learning design that is embedded within the courseware that is being produced.

There are two basic approaches to the realisation of the above objectives. First to base design and fabrication activity on well-established models. Second, to adopt an incremental and iterative development approach based upon the use of design prototypes and the evolution of these into operational assets. Both processes require the implementation of evaluative control processes if they are to be successful. This requirement necessitates asking four important questions: (1) When should evaluation occur? (2) Where should it take place? (3) What should be evaluated? and (4) How should evaluation be conducted?

In this workshop each of the above questions will be addressed by drawing on a range of evaluation activities that we have recently been undertaking within the context of a number of European DELTA and COMETT projects. Two basic types of evaluation will be considered. First, the summative evaluation of existing products in order to separate 'the good from the bad'. Second, the in-process formative evaluation that is necessary to steer a product towards its region of acceptability.

European academic software award - the European joint initiative for promoting quality software in higher education

H. Hanke (Academic Software Cooperation ASK, University of Karlsruhe)
N. Hammond (Department of Psychology, University of York)

The European Academic Software Award (EASA) has been created to stimulate the development of high quality software for education and research. Software is generally recognised to be a key factor which the European market will need to exploit to remain competitive. Universities and colleges must therefore seek to develop appropriate software and use it with students in all disciplines and at all levels of study.

The European Academic Software Award programme is a forum for European software authors to gain academic recognition for their efforts. It offers academic software authors the unique opportunity to enter their programs into a broad competition that acknowledges software as a substantial contribution to education and research.

The European Academic Software Award is a joint initiative organised by ASK (Germany), ALT (United Kingdom), BMWF (Austria), Council of the Renewal of Undergraduate Education (Sweden), iecProGAMMA (The Netherlands), BIP INFO S.A. (Switzerland), CNRS (France), NITEC (Ireland). It is supported by the European Community and Springer Publishers Heidelberg.

The authors will
- give an overview about the European software situation in higher education in correspondence to the goals of the EASA programme,
- summarise the history of the EASA, based on the work of the German Austrian Academic Software Award which held four annual competitions involving more than 1000 software authors,
- discuss the evaluation criteria and underlying rationale for making judgements about academic software

Evaluation of computer simulations of undergraduate laboratory practical classes in biomedical sciences

D. Dewhurst (Faculty of Health and Social Care, Leeds Metropolitan University)

We have developed a range of over 15 computer programs designed to offer an alternative, student-centred approach to conventional laboratory practical classes in those institutions where the facilities or technical/academic expertise to run the 'live' sessions is not available. In addition in the biomedical sciences such programs may overcome some of the ethical problems of using animals in undergraduate teaching.

Here we describe the development and evaluation of two such learning packages designed for undergraduate students **(Intestinal Absorption and Intestinal Motility).** They are written in Turbo C++ (Borland) to run on IBM PC compatibles with EGA or VGA graphics. Both packages comprise interactive software and printed support materials and are designed to teach by investigation and to simulate as many of the student-centred tasks demanded by the conventional approach. Typically a combination of text and high-resolution colour graphics (including some animation) is used to cover the essential background information the student requires, to describe the preparation, the experimental methods, and aspects of data analysis etc. The main section then offers the student the opportunity to collect data from a range of investigative experiments.

The programs were evaluated with undergraduates from two universities by comparing groups using CAL with those taught by conventional methods. The evaluation assessed knowledge gain, student attitude/impressions of the programs (by questionnaire) and compared the resource requirements of the two approaches. The results revealed that CAL offered a cost-effective alternative to laboratory practicals. Students were not disadvantaged by using CAL: primary learning objectives were achieved, there was no significant difference in knowledge gain, students had a positive attitude to using CAL and there was a considerable financial saving.

WORKSHOP 16 - CAL DEVELOPMENT METHODOLOGIES

An effective authoring methodology for the systematic production of courseware

K. Tait (Computer Based Learning Unit,The University of Leeds)

The methodology separates, as far as is possible, the design and production of the three main aspects of courseware: the content (what is to be learned), presentation (the appearance of the courseware) and interaction (how the learner works with the courseware). The paper will elaborate the methodology by describing and discussing a system called the Interactive Document Compiler (IDC) which is consistent with it. IDC has been developed in Toolbook and consists of a compiler shell to which 'formats' are added that determine both presentation and interaction. The content is specified through marked up text (consistent with the Standard Generalised Markup Language) which also references further resources such as images, animations, and other applications. The output from the compiler is a Toolbook application using the presentation and interaction of the formats with the content from the source file. Formats can be modified, new formats created, and compilers customised by adding and removing formats.

IDC has weaknesses as well as strengths and these will be discussed. Issues which will be addressed are reusability, the roles and expertise of courseware designers and subject-matter experts, the structure of content, the evolution of courseware and the applicability of the methodology to the large scale production of information-based computer-based learning materials with a long life-expectancy employing a small number of styles. IDC is currently in use at the University of Leeds.

Adding value to TLTP

S. Price and J. Probert (Centre for Computing in Economics, University of Bristol)

TLTP has the potential to deliver significantly more than the courseware specified in the bids submitted to the UK Higher Education Funding Councils by TLTP Consortia. Indeed, it has frequently been suggested that TLTP is not just concerned with deliverables but with bringing about a cultural change in the provision of teaching and learning. However, for this change to occur TLTP must not only deliver its specified teaching materials but also deliver the tools, procedures and skills to maintain, update and extend these materials.

In funding TLTP, the HEFC has given UK Higher Education a substantial international lead in the field of Computer Based Learning. If this lead is to be maintained and extended, TLTP projects must deliver a process, not just a product.

This paper presents the TLTP Economics Consortium's approach to addressing this requirement for sustainable change. It outlines the key features of these "secondary" deliverables and suggests their applicability to TLTP projects in general.

Active learning in architectural technology

E. Ng (School of Architectural Studies, University of Sheffield)

One of the many criticisms of early efforts in multimedia based teaching, learning and information systems is that most of the development is focused on constructing closed systems, and that once they are completed, altering their content, especially by third party users, is next to impossible. This leads to two problems. First, in the current funding environment, it is almost impossible to sustain the system. Second, the system thereby developed is not very flexible and hence can be difficult to use. In Sheffield, we are trying to address this problem by constructing an open system. Using an interface-less data structuring system, an object oriented technique has been developed to separate the interface from the generic files thereby allowing unlimited posthumous alteration and adaptation. A prototype has been developed in Hypercard and in Director, but the beauty of the system is that it can be adapted to run on almost anything.

WORKSHOP 17 - SUPPORTING THE LEARNER AT A DISTANCE

CLASS: a collaborative learning and studying system

P. Stott and R. Beresford (Department of Information Science, University of Portsmouth)

This paper investigates the enhancement of computer assisted learning via the provision of a computer supported collaborative working facility. Advances in communication technology mean the geographical isolation of the distance learner should no longer exclude them from membership of a virtual class. The collaborative learning and studying system (CLASS) discussed in this paper is a practical implementation of this concept.

CLASS is modelled upon a method used to assess students studying for a Master of Science degree in Information Systems. This method, called a 'Supervised Work Session' (SWS), requires students to work collaboratively in small groups, typically 3-4, on the given assessment material. On completion of the SWS students submit both a group and individual report. The SWS scenario raises many of the issues associated with collaborative learning within well defined boundaries.

A functional prototype CLASS application was built using Windows based rapid development tools. CLASS presents the user with facilities available in a classroom based SWS, i.e. the ability to form groups (sharing sets), the ability to communicate between group members, to have access to a shared drawing area and access to assessment/course material. Guidance is available via a link to the supervising lecturer. An important feature is the ability to form links between different sharing sets; expanding the collaboration across groups.

A summative evaluation of the prototype was carried out by a sample of current students. The results and conclusions drawn from this evaluation are discussed in this paper. Computer supported collaborative learning offers many opportunities for some of the limitations of traditional CAL material to be side-stepped by the inclusion of other humans, both learners and teachers, in the application. The effect of there being other people in the computer learning environment is examined from a practical standpoint.

Widening access to higher education - using ISDN

H. Milner (Learning Development Services, University of Sunderland)

In 1993 the University of Sunderland won one of BT's University Development Awards which has provided opportunities for non-traditional learners to link with the University using modern communications technologies.

The "Gateway to Learning" project began in October 93. A print-based open learning package, "Microcomputing Skills", was developed and distributed to 75 learners from diverse backgrounds. The project enabled learners to collaborate with each other, as well as gain support from on-campus tutors, using video- and desk-top-conferencing.

The project has been used as a pilot to evaluate and promote flexible learning, using materials and networking, in the local community. The pilot is being extended to more sites and more modules. The students are offered a modular menu - of which they can take one or many parts of level one modules. It is intended that more modules will be offered each year.

The learning centres, within the community and linked to a hub institution, provide: the recruitment of learners onto programmes and the guidance required; access to equipment on which to learn new skills and to communicate with a tutor and other learners; and the provision of other resources. The University itself is shifting to a learner centre approach devolving much of the curriculum specific resources to the academic centres - this leads to new roles for all staff.

This workshop will provide a short background to the project and highlight future plans. If possible there will an opportunity to talk with learners who have been involved in the project using a live ISDN link to Sunderland. The workshop will engage participants in lively discussion about realistic applications for ISDN in higher education.

Evaluating Just-In-Time Open Learning

M. Saunders and J. Machell (Centre For The Study Of Education And Training, Lancaster University)

This proposal for a paper describes the work of the authors in relation to a current project: JITOL (Just-In-Time Open Learning).

JITOL is a project within the DELTA (Development of European Learning through Technological Advance) Programme. It has the status of a pilot study. The broad objective of the project is to undertake, and evaluate, large scale pilot implementations of an IT (Information Technology)-based open learning environment for the professional development of individuals. In common with other DELTA projects, the participants in JITOL are drawn from several countries and represent both academic/research institutions and the private sector. 'Just-in-time' access to appropriate knowledge is being made available to users through the use of electronic communications networks. Murray Saunders and Joan Machell are co-ordinating the evaluation of this project which involves partners from France, Italy, Switzerland, Belgium and Norway.

The proposed paper will describe

- the pedagogical rationale of the project
- issues in formulating an evaluation strategy
- preliminary evaluation findings
- some general conclusions on the applicability of the JITOL approach

WORKSHOP 18 - DEVELOPING AN INSTITUTIONAL LEARNING AND TEACHING STRATEGY

A strategic approach to broadening the range of teaching and learning methods in use in the core curriculum: an institutional case study.

M. Thorne (Pro Vice Chancellor, University of Sunderland)

This paper will describe a strategic institutional approach to the development of teaching and learning based on strategies for IT, Broadcasting, Information Services and Teaching and Learning. This is under-pinned by a massive (more than 300 courses per year) institutional staff development programme, principal lecturers in every academic school to spearhead development, and a Learning Development Service which has a mission of altering core curriculum and which is determinedly not a thinly disguised educational research unit.

Much careful thought has been given to the balance between paper-based and technological approaches, and to the means of extending their use across the institution. There are, of course, many important issues in the relevant management of change which must be resolved if the end result is to be a contribution to *core* teaching and learning activity, rather than having marginal effects. And these issues relate to students, not just to academic and support staff. The paper will describe some of the issues encountered and the original approaches taken to deal with them.

The impact of some critical institutional and strategic issues on the implementation of a university wide teaching and learning policy.

A. McCartan and M. Hodgson (Information Technology Service, University of Durham)

Following an outline description of the project and some subsequent developments delegates will be presented with case study material from some representative (though fictitious) universities. This will be designed to raise some critical institutional and strategic issues such as the influence of different organisational structures and funding allocation mechanisms, different ways in which IT may be used, how these would affect the delivery of teaching and their impact on training provision for staff. Delegates will be asked to discuss the likely impact of these issues on the formulation of a strategy to implement a teaching and learning policy, the purpose of discussion in the latter half of the workshop. They will be asked to determine institutional priorities and to consider their impact on training provision for staff. The points raised will provide useful background information for the further development of the related TLTP project, Core IT Skills for Teaching and Learning in Higher Education: Tools for the Development of a National Framework. This project is the work of a consortium, comprising eleven universities nation-wide, with the University of Durham as the lead institution.

The development of a new learning environment at the University of Humberside

S. Shipley (Learning Support, University of Humberside, Hull)

This paper:

Describes the University of Humberside's commitment to move to a New Learning Environment (NLE).

Notes the main features of the NLE which have much in common with recent proposals by Professor Macfarlane.

Considers in detail how the NLE decision has affected the teaching and learning of basic IT.

Notes how a variety of approaches in the past were both individually expensive and even more expensive because of their diversity.

Describes the new approach using Open Learning texts studied in timetabled sessions with attendant support staff.

Describes how we have moved form the old approaches to a single new approach noting particularly:

the formation of an IT Learning Group with wide representation;
the problems of vested interest;
the importance of staff selection - technically aware support staff rather than technical staff;
the importance of staff development;

Notes that the relatively low - technology approach is both intrinsically valuable and a useful precursor to the adoption of more high - technology approaches.

WORKSHOP 19 - PROMOTING AND SUSTAINING CHANGE

Implementation of teaching and learning technology in higher education

R. Rist (Institute for Computer-Based Learning at Heriot-Watt University, Edinburgh)

The TLT programme is funding 76 projects and many of these are producing materials which will be available to all UK Higher Education Institutions in the next year or so. What will be the uptake of these materials?

This workshop aims to help participants to identify the factors that will encourage the implementation of these materials and those that will inhibit their uptake.

The workshop should be of interest to TLTP producers and those in institutions intending to use their products.

The workshop will start with a short introductory talk outlining the obstacles to implementing TLT materials and describing the approach to be taken in implementation support by the "Learning Technology Dissemination Initiative" funded by the SHEFC. Small group discussions are expected to focus on:

- Adaptability/tailorability/reusability of courseware
- Adaptation of courses
- Student access to materials
- Technical/management problems for delivery
- Institutional infrastructure and support
- Support for evaluation of effectiveness of new courseware

HANDS-ON WORKSHOPS H5 AND H6

Full colour movies and images in Macintosh and windows-based CAL applications.

F.Bowser-Riley (Biomedical Sciences, Marischal College, University of Aberdeen)
J. Aiton (School of Biological & Medical Sciences, University of St Andrews)

A series of programs and practical exercises will be available to show how to produce and incorporate high quality full colour still and moving images into CAL material on both Mac and Windows based PC platforms. The workshop will be based on explanatory booklets which contain a series of self-paced exercises showing how to prepare and use full colour images and movies on networked teaching platforms.

The course will give a general introduction and include the following topics:

1. Selection of primary images and movie capture parameters
2. Conversion between Macintosh and MS Windows
3. Selection of the best parameters for use on standard teaching platforms
4. Incorporation of movies and images in Hypercard 2.2 & Asymetrix Toolbook 3.0

Whilst conversion of MacCycle (a CAL image and movie menstrual cycle database) from Hypercard to Toolbook will be used as the main illustrative example, participants are invited to bring their own images and movies as additional material. MS Video for Windows and Apple Quicktime will be the main programs employed to operate and display movie material. The application of Iterated Systems Ltd fractal image compression will be offered as an option on Windows based platforms.

Course prerequisites are a sound knowledge of the basic microcomputer operation (either Windows or Mac).

Text-based and computer-based learning materials in the teaching of structural mechanics - an integrated approach to course development.

R. Hulse (School of The Built Environment, Coventry University)
P. Crowley (School of Engineering, Coventry University)

The paper will describe the development, implementation and use of a completely integrated approach to the teaching of Mechanics developed at Coventry University and now used as an essential approach to learning within all first year Engineering and Building courses.

The teaching system consists of a number of elements based around a course text book which all students are required to purchase. The text has been developed in a programmed learning format providing each student with a clearly defined programme of self learning material which can be tackled at the student's own pace. An additional text provides an examination primer to prepare students for sessional examinations. The most innovative aspect of the package is the provision of high quality computer based tutorials consisting of several hundred highly visual tutorial questions provided within an open-access computer facility. Using these tutorials, which are based on and closely integrated with the course text, students can assess their own progress, receive instant feed-back on performance including recommendations for progress, be encouraged by "hints" when answering incorrectly and improve their abilities by repeating the tutorials at their own convenience. Randomised choices of questions and answers ensures that the process is one of learning rather than rote memory. A range of similar computer-based phase tests enables the lecturer to test student understanding on a regular basis and to quickly determine individual and class performance but without the tedium of marking.

The whole package has been developed and "student tested" systematically over a number of years. It is seen by its users as a highly successful integrated approach to the teaching of mechanics which truly addresses the issue of student-centred , resource-based learning.

Keynote Address

Toward A National Learning Infrastructure

W. Graves, University of North Carolina

Education is in transition. Public leaders and educational leaders alike believe that education must be restructured if it is to remain the cultural and economic foundation of a prosperous democracy into the next century. But there are more exhortations to restructure than prescriptions for doing so. Perhaps the most promising vehicles for change are the same computer and video networks and technologies that are driving the industrial economy into the knowledge economy along the "information superhighway." Our instructional models are substantially dependent on time, place, and institution, but today's evolving network of multimedia computers and information resources potentially removes these dependencies. We need to design new instructional models giving learners immediate access to information and immersing them in interactive worlds crafted from the new technologies to engage all of thé human senses in learning. We know that education should be engaging, but we also know that high-tech entertainment is not necessarily educational. We educators will have to join forces with education's non-profit and commercial supporting cast to shift the old capital- and labor-intensive instructional infrastructure of mortar and lectures toward a new national learning infrastructure based on digital technology and intellectual capital. Only then can we hope to restructure our enterprise to contain its cost and to optimize access to education and our contribution to the quality of learning.

Professor William H Graves, Biographical Sketch

Bill Graves earned a Ph.D. in mathematics from Indiana University in 1966. In 1967, he joined the faculty at the University of North Carolina at Chapel Hill, where he now is Associate Provost for Information Technology, Professor of Mathematics, and Professor of Information Science. He has served the University in other capacities, as well, to include two terms as Associate Dean for General Education and an interim term as Vice Chancellor for Academic Affairs.

As Associate Provost, Professor Graves has institutional responsibility for a range of computer and video technologies, networks, classrooms, and services. He is also responsible for the University's Institute for Academic Technology, which has been funded by IBM since 1989 when he proposed this collaborative effort to advance national educational goals. The Institute emerged from his earlier work with IBM, first within the University to create software development opportunities in the general education program and then nationally to help create the IBM Consulting Scholar Program.

Professor Graves has given over 200 invited presentations on the role of information technology in education and has written and edited extensively on the subject. He currently chairs the planning committee for EDUCOM's National Learning Infrastructure Initiative. EDUCOM's 600 member colleges and universities and 100 corporate associates are helping to shape the national information infrastructure, and the goal of the Initiative is to apply this collective knowledge of the new infrastructure to foster new instructional delivery models that are learner centered, broadly affordable, and scalable.

Whether working with the educational community and its supporters on his campus, at the Institute for Academic Technology, or in the National Learning Infrastructure Initiative, Bill Graves is motivated by the belief that education's future depends on how effectively and efficiently it deploys information technology to improve instruction and public service.

Alt Administration
University of Oxford
13 Banbury Road
Oxford
OX2 6NN
UK

internet: Alt@vax.ox.uk tel: +44 (0)865 273281 fax: +44 (0)865 273275